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CONTENTS

Labor and the Law. *By Julian Chase* 611
Business in Brief 613
Piston Ring Blow-by. *By C. G. Williams and H. A. Young* 614
Just Among Ourselves 623
Automotive Materials 624
Men and Machines 626
Engineering Drawings of the Morris Ten-Four Engine and Transmission 629
Production Lines 631
Gasoline Engine Combustion (Part Two). *By Hector Rabezzana, Stephen Kalmar and Alfred Candlise* 632
Template Tool Bit Grinder 639
Transmission Designed for Heavy Duty Service 640
Diesel Line Expanded by Hercules 640
Deco Hand Pump Tests Injectors on the Engine 641
Completely Automatic Self-Cleaning Filter 642
News of the Industry 643
Advertisers' Index 78

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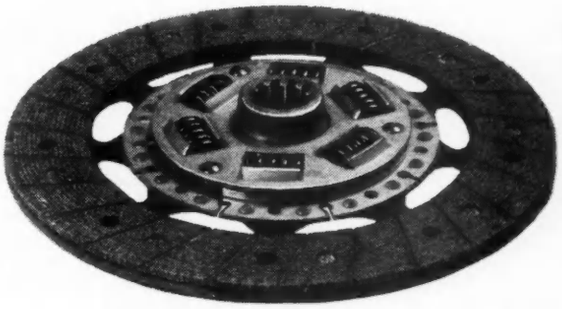

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AUTOMOTIVE INDUSTRIES

Published on the 1st and 15th of the month

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Labor and The Law

A formula of procedure must be evolved that will safeguard both the worker and the public good

By JULIAN CHASE

COMPREHENSIVE regulation of labor union activities by law, with all of labor's basic rights carefully safeguarded, is a nationally important development toward which we have been heading for a long time. Today, more than ever before, it seems that some additional form of restrictive or at least more clearly definitive legislation is sooner or later inevitable. And there are those who believe that, for the benefit of all, it should come sooner rather than later.

Except for short-view political expediency there does not seem to be much that can more than momentarily check the natural consequences of this trend in national thought. The best chance that the real leaders of organized labor had to forestall such legislation, lay in the opportunity which past years provided for the adoption and demonstration by them and their subordinates of the same broadly sensible and beneficient attitude toward the public good that they rightfully expect and have expected of industrialists and employers generally.

It has been urged by some that the present national administration, which has manifested an extremely liberal and friendly attitude toward labor, is in a better position to accelerate and crystalize a movement of this kind than any coming administration we are likely to have in the critical near future. One reason for this belief is, of course, that there could not reasonably be any suspicion on the part of our organized labor groups regarding the motives prompting such an effort put forth by our present national leaders. In the judgment of the holders of this belief, there is a peculiar responsibility resting on the present administration because of that fact. They feel, moreover, that if it does not act by giving diligent support to the movement, an opportunity unique in our history will have been wasted when it should have been improved for the advancement of our economic and social welfare.

It is held, furthermore, that while we can not with any justice charge the New Deal with sole responsibility for the demoralizing effects of labor strife on our productive system during the past few years, we can, nevertheless, charge it with acts and attitudes, with doings and not-doings which tended definitely to intensify the harmful character of both the direct and indirect effects, the latter, probably, being the more serious. To those who hold these views, therefore, it seems that the present administration has created for itself simultaneously an especial duty and the opportunity to liquidate both that duty and an inherited responsibility which has been growing with the concurrent growth of organized labor power.

Whether or not President Roosevelt had our labor problem partly in mind when he made a possibly significant statement in his message to Congress soon after the elections of 1938, he alone knows. Recognizing that there are flaws and imperfections in some of the things that have been done since he has been in office, he said, "We see things now that we could not see along the way. * * * We had to forge new tools for a new role of government in democracy. * * * Some of these tools had to be roughly shaped, and still need some machining down." We can, at least, hope that his list of things to be sent back to the shop for alterations includes the National Labor Relations Act. It will probably get there anyway but his help will expedite the necessary job of reconstruction.

The extra legal protection of the right of workers to organize and bargain over wages and working conditions collectively, provided by the Wagner Act, imposes on workers and particularly on labor leaders an emphasized obligation to refrain from all forms of illegal activity in the exercise of that right. If labor leaders do not see to it that lawful courses are followed, then government must.

GENERAL

One seriously disputed point that should be and probably will be cleared up at the earliest possible moment is that concerning the exemption or non-exemption of labor organizations under our anti-trust laws. Attorney General Murphy and his helper Thurman Arnold believe that if there is any such exemption at least it is not complete and they are proceeding on that basis. On the other hand, William Green of the A.F. of L., one of the ablest of our labor leaders, vigorously asserts "that no labor organization or its members can be prosecuted under the anti-trust laws." And then, somewhat losing his customary balance, he adds, "It seems inconceivable to me that an administration notable for its friendliness to labor should adopt a retrogressive policy advocated hitherto only by the most extreme reactionary enemies of labor." As to the retrogressive or progressive character of the policy it can be said that equally competent authorities disagree with Mr. Green. Furthermore, it can also be said with truth that the policy is being advocated by many who can not by any possible stretch of imagination be classed as "reactionary enemies of labor." If it turns out that our Department of Justice is wrong and that labor organizations are now fully exempt, perhaps the law should be and will be changed.

From everyone's point of view it is imperative that clarifying action be taken soon regarding the extent and character of labor's present legal responsibility and the extent and character of the responsibility which it should bear for the general good if it does not carry that responsibility now.

At this moment there has come from the Third United States District Court of Appeals a most interesting, though only partly illuminating, decision in the Apex Hosiery case. The Court says that a judgment of the District Court for triple damages against a labor leader and a labor union will not hold because, among other reasons, the interruption of production and the stoppage of shipments that resulted from an outrageous sitdown strike "had small effect upon interstate commerce." The Court said also that "The evidence in the case before the bar * * * did not disclose an intent on the part of the appellants to restrain commerce. On the contrary, their intent was to unionize the appellee's plant, an action local in motive and local in effect."

Clearly, within recent interpretations of the National Labor Relations Act by the Supreme Court, the Apex company was engaged in interstate commerce. The question arises, therefore, in the layman's mind at least, whether, in the light of the Apex decision this or any similar company, if it refused to negotiate with a union that represented a majority of its workers should be prosecuted under the National Labor Relations Acts. The anti-trust laws use the word "restraint." The National Labor Relations Act uses the word "affect." There is a distinction there of which the full extent will not be known until the Supreme Court has finally shown us the minimum effect that is covered by the word "affect" in the national labor law. But if, as the Third United States Circuit Court of Appeals has said, the unionization of the Apex plant was "local in motive and local in effect" how could the same effects resulting from any action by the management of the company be regarded logically as of national concern?

Further clarification is needed, too, with regard to the rights of individual workers. The restatement in the National Labor Relations Act of the ancient right of workers to organize has apparently been interpreted by professional labor organizers to mean that they have a specially given and protected right to organize them. They have apparently deduced, too, that they are free to do so by whatever means they choose. The process of so-called organization in the automotive industry lends strong support to both assumptions. But, take it from Senator Wagner himself, such interpretations and deductions are not compatible with the unattained purposes of the act. The father of the National Labor Relations Act, in a lengthy and ably presented defense of that measure, published within the past month as a letter to the Editor of the New York *Herald Tribune*, said:

"It is essential first to restate clearly the broad objectives of the act, against which its success or failure must necessarily be

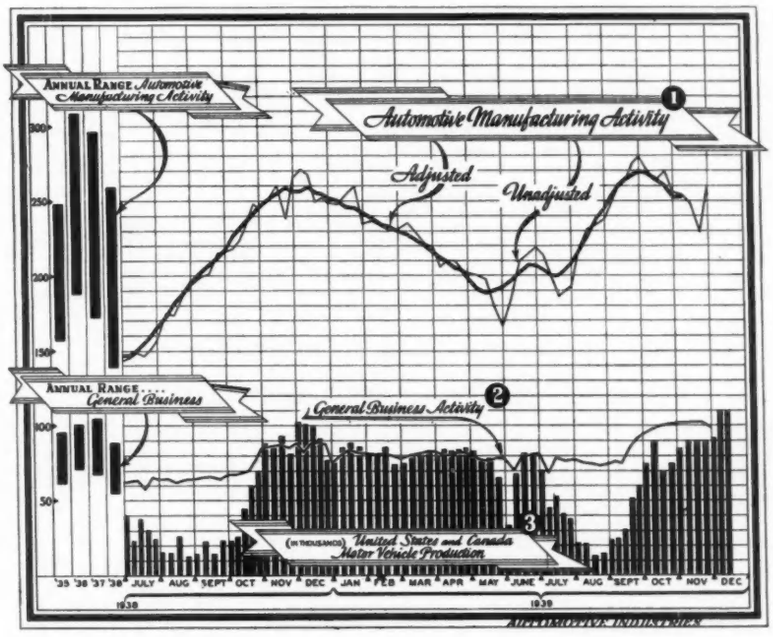
(*Turn to page* 642)

The Brass-Hat Rack

"Every year he holds us up a half-day like this!"

BUSINESS IN BRIEF

Our own view of automotive production and sales; authoritative interpretation of general conditions



Weekly indexes of automotive general business charted

December Output Topping 1938

PRODUCTION of cars and trucks during the first half of December reflected an immediate response to settlement of the Chrysler strike by breaking into considerably higher ground for the 1940 model season.

With other producers continuing to operate at capacity, or close to capacity, addition of the important production of the various Chrysler units to the industry's total saw weekly output reach figures well in excess of 100,000 cars and trucks.

As a matter of fact, production for the week ending Dec. 9 was estimated[2] at approximately 110,000 cars and trucks, and output for week ending Dec. 16 was expected to duplicate that figure. In addition, the industry turned out an estimated 18,000 cars and trucks on the first two days of the month to bring total production for the first half of December to an estimated 238,000 units.

If the current rate is maintained for the balance of the month, December production should be fairly close to 440,000 cars and trucks, a gain of more than 30,000 over December a year ago and the highest monthly total since June, 1937. This would also show considerable gain over November, when output totaled more than 376,000 units, according to preliminary estimates.

An indication of the way in which retail deliveries have been holding up is given by November sales figures released by the Chevrolet division of General Motors Corp. Chevrolet sales for November totaled 89,377 cars and trucks as compared with 76,938 for the same month a year ago. This represents a gain of better than 16 per cent. Chevrolet sales for the last 10 days of November were slightly in excess of 30,000 units as compared with 25,000 units during the same period a year ago, a gain of 20 per cent.

Retail deliveries of Ford and Mercury cars and Ford commercial cars and trucks in November showed a 50 per cent increase over November of last year. The company reports that its dealers delivered a total of 72,308 units to customers during the month, the largest November sales since 1935. Sales of Mercury cars alone were up 97 per cent in November over the same month a year ago.

Domestic retail sales of passenger cars for October showed a 78.56 per cent gain over the preceding October, according to figures compiled by R. L. Polk & Co. New car registrations for October aggregated 212,586 to surpass October, 1938, by 119,053, and to surpass September, 1939, by 50.1 per cent. October sales for this year were the best for this month since 1929. October truck registrations totaled 37,923, which was 93.59 per cent ahead of the preceding October and 14.98 per cent over September, 1939.

AUTOMOTIVE MANUFACTURING ACTIVITY, for some weeks depressed by the Chrysler strike, was bolstered appreciably immediately upon resumption of operations in the corporation's plants. This is clearly reflected by the unadjusted index plotted herewith, which sought lower and lower levels of 248 and 229 during the weeks ending Nov. 18 and Nov. 25, then quickly recovered 32 points in the week ending Dec. 2 to reach 261.

The adjusted index curve dropped five points and went to 260 during the week ending Oct. 28, fell seven more points the next week, and remained at 253 for the week ending Nov. 11.

[1] 1923 average = 100; [2] Prepared by Administrative and Research Corp., New York. 1926 = 100; [3] Estimated by J. A. Laansma, Detroit News Editor, AUTOMOTIVE INDUSTRIES.

Piston Ring Blow-by

—in high speed gasoline engines

Slightly condensed from an interim report to the Institution of Automobile Engineers by C. G. Williams, director of the IAE research department, and H. A. Young, engineering assistant in the IAE research department.

A PROBLEM which has become increasingly prominent in recent years is the excessive gas leakage or blow-by past the piston rings which occurs on some engines at high speeds. In certain severe cases, excessive blow-by is associated with breakage of piston rings, almost invariably adjacent to the ring gap. This is usually attributed to "ring flutter," *i. e.*, to a vibration of the piston rings. It is proposed to describe here some preliminary experiments which have been carried out with the object of studying the conditions under which excessive blow-by occurs, and the influence thereon of certain features of piston ring design.

The experiments were carried out on the following engines: — (1) An overhead valve, water cooled, single-cylinder gasoline engine of 30.5 cu. in. displacement, having a maximum speed of 4000 r.p.m.; (2) an air-cooled racing-type motorcycle engine of 30.5 cu. in., having a maximum speed of 7000 r.p.m.; (3) a limited number of experiments were carried out on a 4-cylinder engine of 77.3 cu. in. displacement, operated at speeds up to 5500 r.p.m.

This engine had a bore and stroke of 3⅜ in., and the normal arrangement of piston and rings is shown in Fig. 1. The following precautions were taken to seal the crankcase from air leakage:—The driving shaft was sealed by means of a spring-loaded felt washer and the push rods by rubber tubing arranged as shown in Fig. 2. The air-tightness of the crankcase was measured by noting the rate of pressure drop in the crankcase after the pressure therein had been increased to about 10 in. water. To trace the origin of air leaks, smoke was blown into the crankcase under pressure. In addition, motoring tests were carried out with the cylinder head removed, any positive or negative reading being taken as an indication of leakage.

The crankcase was connected to an expansion tank (Fig. 3), of 11 U. S. gals. capacity, in order to assist in damping out the rather violent pressure fluctuations which occur in the crankcase of a single-cylinder engine. The expansion tank was connected to a calibrated gasometer, balanced so as to impose negligible back pressure. When not taking readings of blow-by, the gases were allowed to escape *via* a two-way cock. A certain amount of oil was carried over into the expansion tank and arrangements were made to pump this oil back to the oil supply tank. In certain tests on this engine, the carburetor intake was connected to an air box for the measurement of air consumption of the engine.

The mean radial pressure of the piston rings used in the experiments was measured by the well-known method of measuring the force required to close the piston ring gap to its normal value by means of a flexible band wrapped around the periphery of the piston ring. In addition, a measure of the

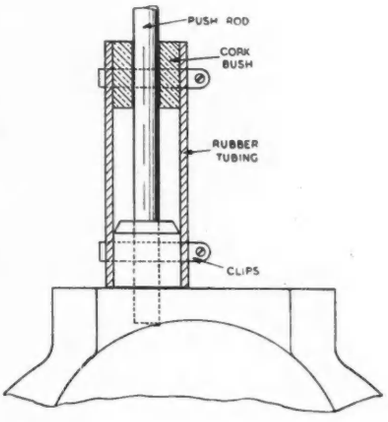
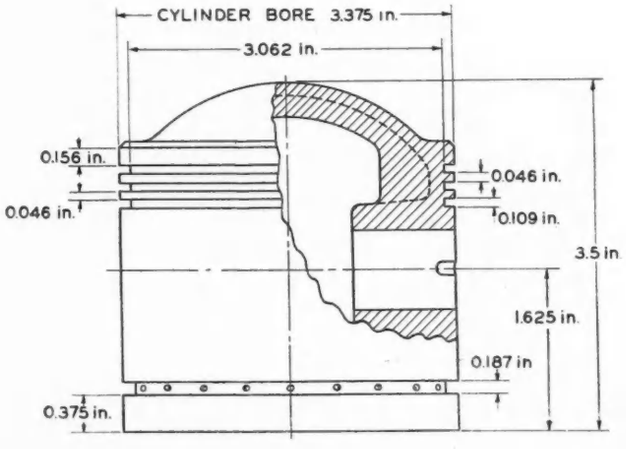


Fig. 1. (Right), Method of sealing tappet guides

Fig. 2. (Lower), Piston of water-cooled, valve-in-head engine tested



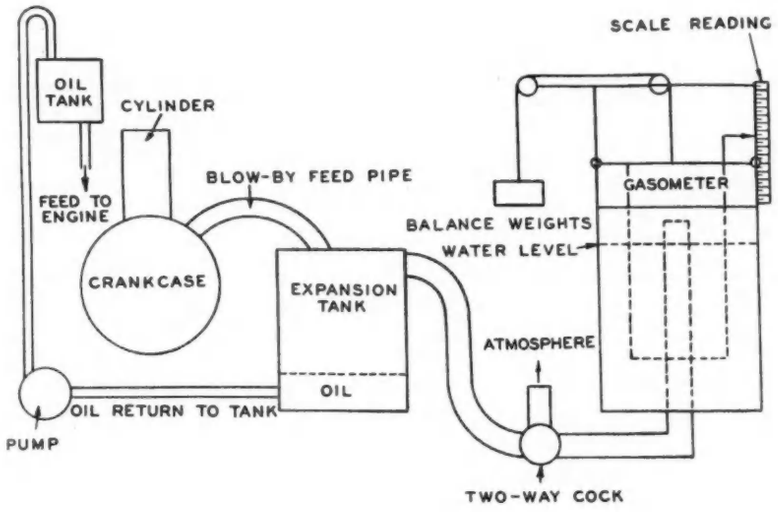


Fig. 3. (Above), Experimental arrangement

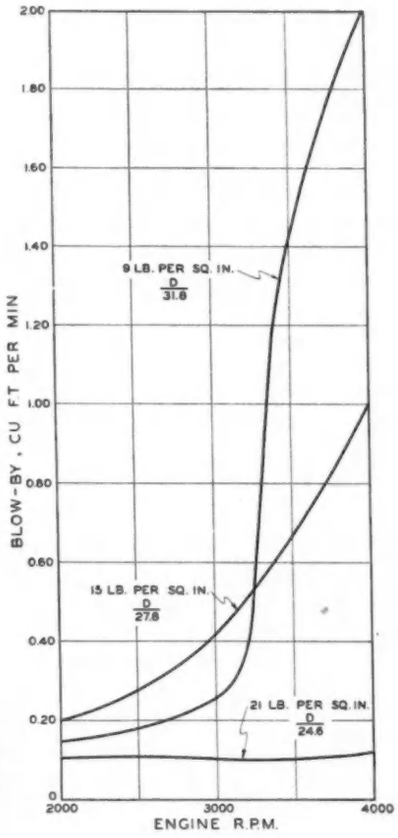


Fig. 6. (Right) Effect of ring radial pressure. Ring width, 0.093 in. Ring side clearance, 0.007 in.

average ring pressure is given by the radial thickness of the ring, expressed as d/k, where d is the bore diameter and k a numeral which is smaller the greater the radial pressure.

The piston rings used on this engine were all heat-formed, and they had a fine ground finish. The usual arrangement was to run the piston rings until inspection showed that they were properly bedded-in. Unless otherwise stated, the tests were carried out at a b.m.e.p. of 58 lb. per sq. in. and with optimum ignition advance.

Effects of Side Clearance and of Radial Pressure

The blow-by is plotted against engine r.p.m. in Fig. 4, for three side clearances of 0.0025, 0.005 and 0.007 in., respectively. The same piston rings were used throughout, having a mean radial pressure of 15 lb. per sq. in. It will be observed that, with the smallest side clearance, there was no increase in blow-by up to the maximum speed of 4000 r.p.m. With the larger side clearances, however, and particularly with the excessive side clearance of 0.007 in., the blow-by increased rapidly from 2000 to 4000 r.p.m., though it is of interest to note that, at 2000 r.p.m., there was little difference in blow-by with all three clearances.

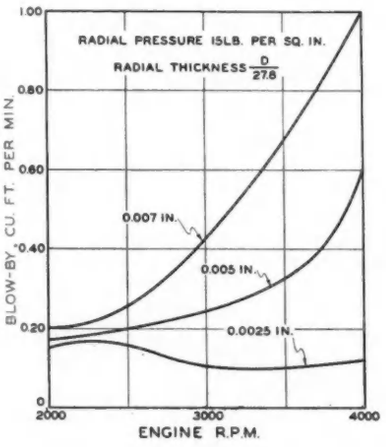


Fig. 4. Effect of ring side clearance. Radial pressure, 15 lb. per sq. in. Radial thickness, D/27.8

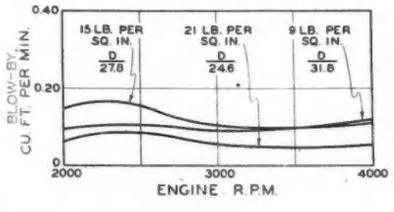


Fig. 5. Effect of ring radial pressure. B.m.e.p., 58 lb. per sq. in. Ring width, 0.093 in. Side clearance, 0.0025 in.

Tests were carried out in which the radial pressure of the piston rings was varied, using the same side clearance of 0.002-0.003 in. throughout. The results, shown in Fig. 5, indicate relatively minor variations of blow-by over the speed range, with no tendency for blow-by to increase at the higher speeds, even with the low-pressure rings (9 lb. per sq. in.). Over the whole speed range, the highest ring pressure (21 lb. per sq. in.) gave less blow-by than the other two pressures examined.

Further tests were carried out in which the radial ring pressure was varied, using an abnormally large side clearance of 0.007 in., and the results are plotted in Fig. 6. These results are of particular interest as they indicate a very marked effect due to radial ring pressure, as contrasted with the negligible effect in Fig. 5, with a normal side clearance. With the high-pressure rings (21 lb. per sq. in.), blow-by was uniform throughout the whole speed range while, with the low-pressure rings of 9 lb. per sq. in. radial pressure, blow-by increased very rapidly above 3000 r.p.m. and, at 4000 r.p.m., reached a value of over 2.0 cu. ft. per min., *i. e.*, more than ten times the value at 2000 r.p.m. The above results therefore indicate that, on this particular engine, excessive blow-by at high speeds could be avoided by (*a*) the use of high-pressure rings, whatever the side clearance; (*b*) a side clearance of 0.0025 in., whatever the radial ring pressure; and (*c*) a combination of the foregoing, *i. e.*, small side clearance and increased radial pressure, as indicated in Fig. 5.

As a matter of interest, the results given in Fig. 6 have been re-plotted in Fig. 7, the blow-by being expressed as a percentage of the air consumption of the engine. It will be noted that, at the lower speeds, the blow-by was between 1 and 2 per cent of the air supply, whereas, with the low-pressure rings at 4000 r.p.m., blow-by exceeded 9 per cent which, apart from other considerations, would obviously have a marked effect on engine power.

An interesting point arises as to the part played by the individual piston rings in encouraging or resisting "blow-by" and "ring flutter." If the top ring is entirely responsible, then it should be possible to obviate its misbehavior by one or more correctly functioning rings lower down. That this is the case is shown in Fig. 8, where comparative results are shown (*a*) with three low-pressure piston rings (9 lb. per sq. in.) with high side clearance, giving high blow-by, and (*b*) with the top ring as before, but with two well-fitting medium-pressure rings (15 lb. per sq. in.) in the two lower grooves. It will be noted that there was only a relatively slight increase of blow-by at high speeds in the latter case.

The same graph shows that very effective sealing could be obtained with only one correctly functioning ring, fitted either in the top or middle grooves.

Effect of Cylinder Bore Distortion

Cylinder bore distortion is obviously at a minimum on a water-cooled single-cylinder engine, and an attempt was made to introduce a distortion effect by machining a cylinder barrel with a "hump." A special cylinder was ground so as to give a reduction of bore diameter of 0.003 in. over a length of approximately ¾ in., the center of the hump being approximately 1¼ in. from the top of the bore. The results for the low, medium and high-pressure rings with excessive side clearance are given in Fig. 9, and indicate that the effect of the hump was to give a more rapid increase in blow-by with the low-pressure rings, the blow-by reaching a somewhat higher value. Some effect was also observed with the rings of high pressure, as also with piston rings having a reduced side clearance, *e. g.*, Fig. 10 shows comparative results with piston rings of 15 lb. per sq. in. radial pressure.

Effect of Rate of Oil Flow

It has been suggested that a possible contributory cause of "ring flutter" is interaction between the piston rings and the film of lubricating oil on the cylinder walls, and that "ring flutter" and blow-by would be accentuated with an oil film of increased thickness. The normal rate of oil fling from the big-end was small, viz., 0.5 gal. per hour. A special oil pump, delivering 80 gals. of oil per hour, was arranged to provide a jet of oil impinging on the big-end. Measurements of blow-by with three medium-pressure rings (15 lb. per sq. in.) having a side clearance of 0.002 to 0.003 in., showed practically no difference in blow-by with these two extreme rates of oil feed, and there was no tendency for blow-by to increase at the high speeds.

Some experiments were carried out to ascertain the effect of the scraper ring, but practically no difference in blow-by readings was observed with and without the scraper ring.

Composition of Blow-by Gases

The following Table indicates the percentage content of CO_2, O_2 and CO in the blow-by gases, together with the corresponding composition of exhaust gas samples taken at the same time as the blow-by samples:

% CO_2		% O_2		% CO	
Blow-by	*Exhaust*	*Blow-by*	*Exhaust*	*Blow-by*	*Exhaust*
1.4	13.0	16.0	0	0.4	1.6
2.0	12.0	15.0	0	2.2	3.8
2.4	13.0	17.6	0	1.2	2.0
1.8	10.6	17.4	0.4	0.6	4.0
1.6	13.2	16.8	0	1.0	2.0

The above analyses are of particular interest as they

Fig. 7. (Top Right) Blow-by as a percentage of air consumption. B.m.e.p., 58 lb. per sq. in. Ring width, 0.093 in. Ring side clearance, 0.007 in.

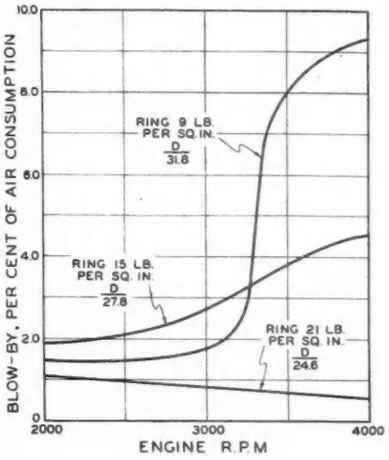


Fig. 8. (Center Right) Blow-by with various ring combinations.

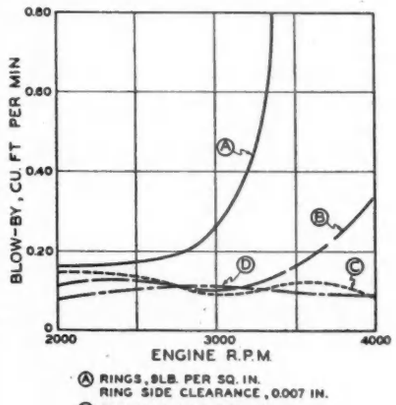

BLOW-BY, CU. FT PER MIN
0.80
0.60
0.40
0.20
0
A
B
D
C
2000
3000
4000
ENGINE R.P.M
Ⓐ RINGS, 9 LB. PER SQ. IN. RING SIDE CLEARANCE, 0.007 IN.
Ⓑ TOP RING, 9 LB. PER SQ. IN. RING SIDE CLEARANCE, 0.007 IN. 2ND AND 3RD RINGS, 15 LB. PER SQ. IN. RING SIDE CLEARANCE, 0.0025 IN.
Ⓒ 2ND RING ONLY, 15 LB. PER SQ. IN. RING SIDE CLEARANCE, 0.0025 IN.
Ⓓ TOP RING ONLY, 15 LB. PER SQ. IN. RING SIDE CLEARANCE, 0.0025 IN.

Fig. 9. (Lower Left) Effect of cylinder-bore distortion.

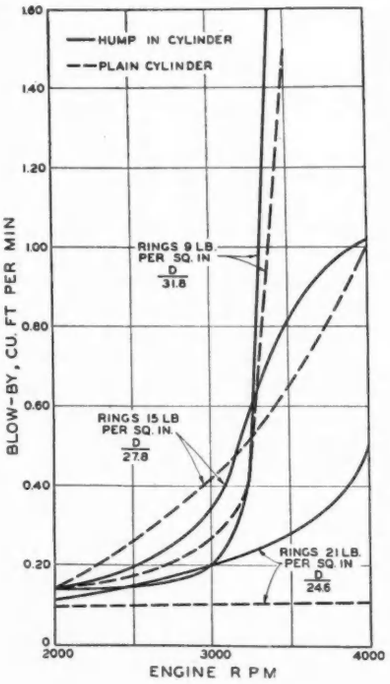
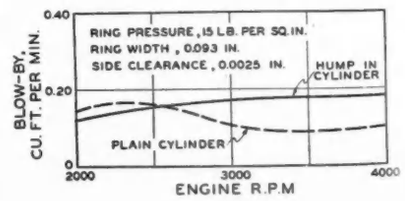


Fig. 10. (Lower Right) Effect of hump in cylinder.



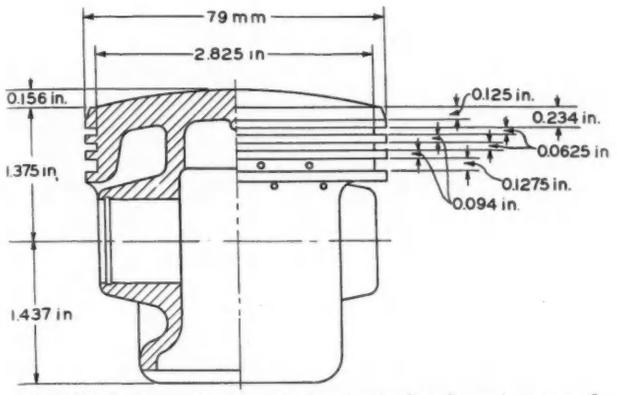


Fig. 11. Piston of air-cooled valve-in-head engine tested.

indicate that the composition of the blow-by gas differs materially from that of the exhaust gas. In fact, the composition of the blow-by gas is such as to suggest that it consists very largely of contaminated air; also, the proportion of CO to CO_2 in the blow-by gases is considerably higher than that in the exhaust gases. These observations suggest that the blow-by gases consist of air leaking past the rings during the latter part of the compression stroke and the early part of the combustion stroke, the latter incorporating some chilled products of combustion which are forced past the piston during the early part of the explosion. In this connection, it is obvious that the unburnt mixture around the periphery of the piston is one of the last portions of the charge to be burnt, so that during pressure rise the leakage will consist largely of unburnt mixture.

Tests on a Single-Cylinder O.H.V. Air-Cooled Engine

Apparatus

This engine has a bore of 3.11 in. and stroke of 3.95 in., and the normal arrangement of piston and rings is shown in Fig. 11. The principal reason for using this engine was that it could be operated for sustained periods at speeds up to 7000 r.p.m. Precautions taken to seal the crankcase from air leakage included a felt washer on the driving shaft, while a packing gland was used round the shaft drive the overhead camshaft. The arrangements used for measuring blow-by were similar to those shown diagrammatically in Fig. 2 for the single-cylinder water-cooled unit, and the same procedure was used in order to check gas-tightness.

The cylinder was cooled by an air blast directed on the exhaust side of the engine, cylinder wall temperatures, measured at an angle of 45 deg. from the inlet valve on the lee side, ranging from 320 deg. to 356 deg. Fahr. Except where otherwise stated, a compounded oil conforming to S.A.E. 50 specification was used.

Effect of Running-In

Experiments were carried out with two types of piston ring in order to study the effect of running-in, the running-in being carried out at 4000 r.p.m. and at a b.m.e.p. of 59 lb. per sq. in. In the blow-by tests, carried out after various periods of running-in, the speed was varied, while the b.m.e.p. was maintained constant at 59 lb. per sq. in.

In Fig. 12 are shown the results of tests carried out with piston rings having a mean radial pressure of 14.1 lb. per sq. in., the "ovality" being high, viz., 0.026 in. The "ovality" is the difference in diameters of

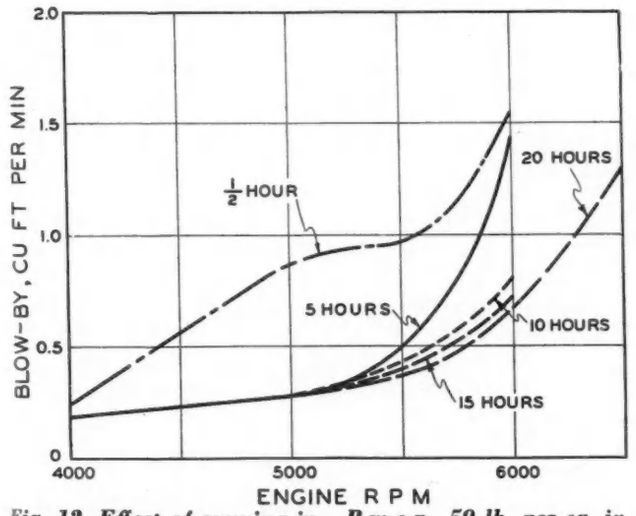


Fig. 12. Effect of running in. B.m.e.p., 59 lb. per sq. in. Ring radial thickness, D/28.5. Ring specific pressure, 14 lb. per sq. in. Heat-formed, ground on periphery. Ring width, 0.060 in. Ovality, 0.026 in.

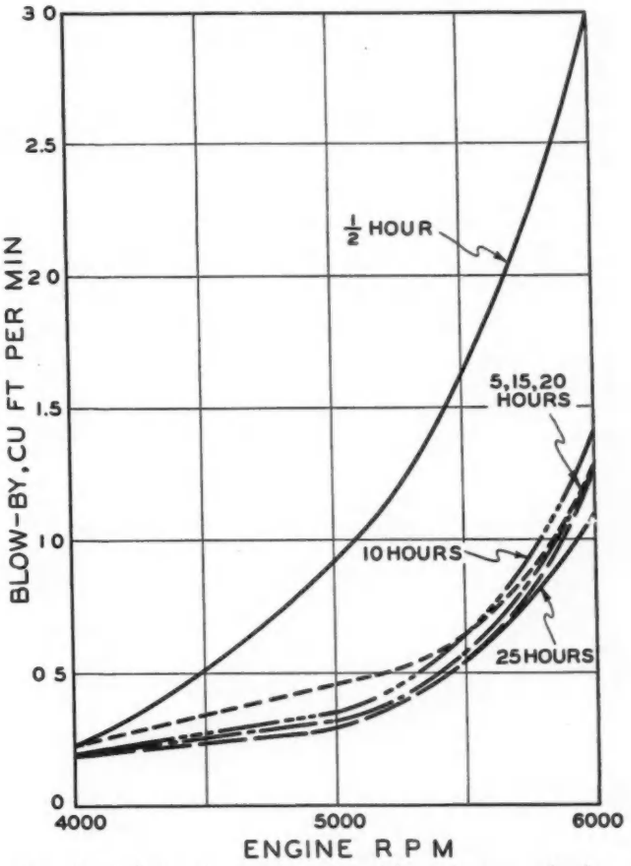


Fig. 13. Effect of running in with taper-ground rings. B.m.e.p., 59 lb. per sq. in. Ring radial thickness, D/28.5. Ring specific pressure, 14 lb. per sq. in. Heat-formed, taper-ground on periphery. Ring width, 0.060 in. Ovality, 0.014 in.

the piston ring, in the closed position, measured along and at right angles to the gap, and is usually taken as a measure of the "point pressure" of the ring. The blow-by, in cu. ft. per min., is plotted against engine speed for various periods of running-in. After the new rings had been run for half-an-hour, they showed high blow-by at speeds above 4000 r.p.m. Five hours' running-in reduced the blow-by very considerably at 5000 r.p.m., but high readings were still obtained at 6000 r.p.m. Further sets of readings, taken after 10, 15 and 20 hours' running-in, showed an appreciable reduction at 6000 r.p.m., there being little difference in the readings taken at 10 and 20 hours, respectively. These results, therefore, indicate that blow-by was high on new rings, and they emphasize the necessity for adequately running-in rings in order to obtain reproducible results.

Similar tests were carried out on piston rings of the same mean radial pressure and of lower ovality, but which had been taper-turned on the periphery about 0.5 deg., the smaller diameter being uppermost. The results, shown in Fig. 13, indicate very high readings on piston rings which had been run-in for only half-an-hour. Thus, comparing Fig. 12 with Fig. 13, the respective blow-by figures at 6000 r.p.m. were 1.5 and 3.3 cu. ft. per min., respectively. On the other hand, Fig. 13 illustrates the more rapid running-in with taper-turned rings, the blow-by characteristics having reached approximate stability after 5 hours' running.

Effect of B.M.E.P.

In these tests, the b.m.e.p. was maintained at various constant values over the speed range and the results, illustrated in Fig. 14, were obtained using piston rings 0.088 in. wide and of 9 to 10 lb. per sq. in. mean radial pressure. The results show that the speed above which blow-by increased rapidly was lower the smaller the b.m.e.p., *i. e.*, for b.m.e.p. values of 35.4, 59 and 94.5 lb. per sq. in., the critical speeds were in the region of 4100, 4600 and 5100 r.p.m., respectively. This is a result of considerable interest as it suggests the possibility that on some engines the critical conditions of blow-by may only be reached when coasting on a down-grade or, perhaps, when using the engine as a brake. In the tests depicted in Fig. 14, the top piston ring broke adjacent to the gap in the tests at the two higher loads.

Effect of Ring Side Clearance

The importance of this factor has already been indicated in the experiments on the water-cooled unit, and the results on the high-speed, air-cooled unit are shown in Fig. 15, the side clearance being increased in stages from 0.005 in. to 0.009 in. by lapping down the sides of the ring. With the smallest side clearance of 0.005 in., the blow-by increased above 5250 r.p.m., reaching 1.0 cu. ft. per min. at 6500 r.p.m. With the largest side clearance of 0.009 in., the blow-by increased rapidly between 4500 and 5000 r.p.m., thereafter increasing somewhat slowly up to 2.1 cu. ft. per min. at 6000 r.p.m.

Unfortunately, the piston and rings available for these particular tests did not allow a side clearance smaller than 0.005 in. The results of Fig. 15 suggest that the blow-by would have been reduced still further by a side clearance of, say 0.003 in.

It may be mentioned here that tests on narrower rings, discussed in the next section, showed that, over the range studied, blow-by was practically unaffected by ring side clearance.

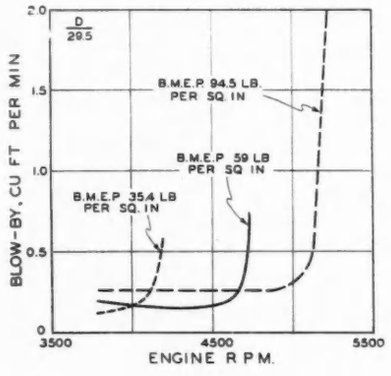
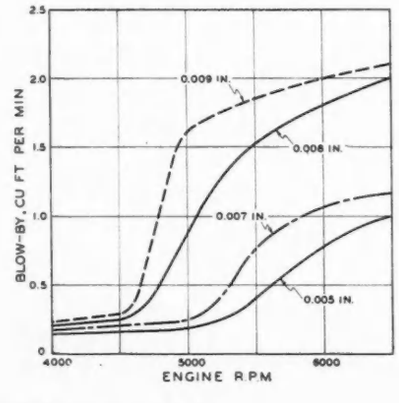
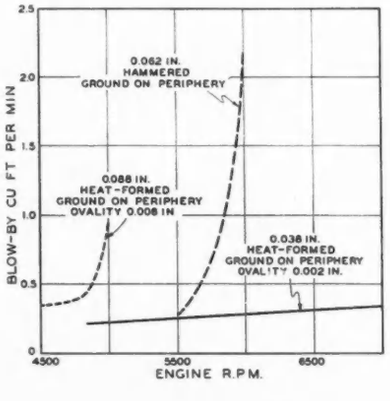


Fig. 14. (Top Left) Effect of B.m.e.p. Ring pressure, 9-10 lb. per sq. in. Ring width, 0.088 in. Ovality, 0.014 in.

Fig. 15. (Lower Left) Effect of side clearance. B.m.e.p., 59 lb. per sq. in. Ring radial thickness, D/29.2. Hammered, ground on periphery. Ring specific pressure, 8-9 lb. per sq. in. Ring width, 0.061 in.

Fig. 16. (Below) Effect of ring width. B.m.e.p., 59 lb. per sq. in. Ring radial thickness, D/29.2. Ring specific pressure, 8-10 lb. per sq. in.




0.062 IN. HAMMERED GROUND ON PERIPHERY
0.088 IN. HEAT-FORMED GROUND ON PERIPHERY OVALITY 0.008 IN
0.038 IN. HEAT-FORMED GROUND ON PERIPHERY OVALITY 0.002 IN.
BLOW-BY CU FT PER MIN
ENGINE R.P.M.

Effect of Piston Ring Width

A special series of pistons was made to take piston rings of three different widths, viz., 0.38 in., 0.062 in. and 0.088 in. The depth of the top land was the same on the three pitsons. The radial pressure of the piston rings fell between the limits of 8.7 and 9.2 lb. per sq. in. The tests were all carried out at a b.m.e.p. of 59 lb. per sq. in.

The results, plotted in Fig. 16, showed that, with the widest rings, the blow-by increased above about 4600 r.p.m., the top ring breaking at 5000 r.p.m. With the narrower ring of 0.062 in. width, blow-by did not increase until a speed of 5500 r.p.m. had been exceeded, ring breakage occurring at 6000 r.p.m. With the narrowest ring width of 0.038 in., there was a slight increase of blow-by with increasing speed, but no sudden or marked increase occurred up to the maximum speed of 7000 r.p.m., and no ring breakage occurred.

These experiments, therefore, dem-

onstrate very effectively the marked effect of narrow ings in increasing the speed at which excessive blow-y occurs.

Effect of Ring Gap

Frequent ring breakage occurred on this high-speed engine under conditions of excessive blow-by, and since here were indications from bright areas on the ring joints that butting had been taking place, it might be inferred that, whatever the explanation of "flutter," ring breakage was the result of impact stresses set up by violent closing of the ring gap.

A series of tests was carried out in which the ring gap of the top piston ring was varied, that of the lower pressure ring being kept at its normal value of 0.035 in. The piston rings had a radial pressure of 8 to 9 lb. per sq. in. and the gap was increased in stages by filing.

Results are shown in Fig. 17. With the normal gap of 0.035 in., the blow-by was high at 6000 r.p.m. and the top ring broke after about a minute's running at that speed. An increase in ring gap to 0.045 in. did not effect any notable alteration in blow-by characteristics, but with this size ring gap butting could still occur. With a ring gap of 0.065 in. butting could also occur, but ring breakage did not take place until a speed of 6500 r.p.m. had been reached, and the blow-by curve "flattened-off" at that speed. In order to avoid all possibility of butting, the gap was increased to 0.150 in., and a piston was used having an increased diameter at the base of the groove, so that any collapse or vibration of the piston ring would result in the inner periphery of the ring grounding on the ring groove. The results, shown in Fig. 17, indicate appreciable improvement in blow-by at the higher speeds, but ring breakage occurred at 6500 r.p.m. It will be noted, however, that with these excessive gaps the blow-by at the lower speeds was doubled, probably owing to normal gas leakage through the gap.

The above results, therefore, suggest that some alleviation in blow-by can be achieved at the higher speeds by using a ring gap of rather impracticable size, and also that butting of the rings is not an essential factor in ring breakage. In the present experiments, although such butting was prevented with an excessive ring gap, breakage might result from stresses set up by impact against the cylinder walls, or against the base of the ring groove.

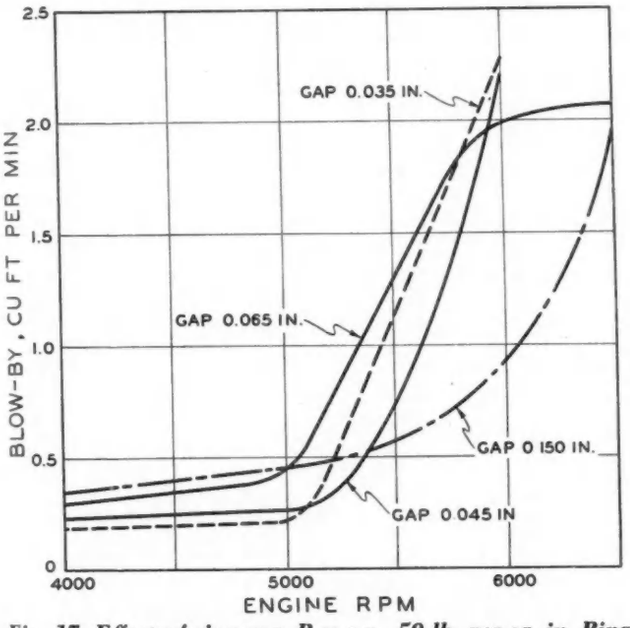


Fig. 17. Effect of ring gap. B.m.e.p., 59 lb. per sq. in. Ring radial thickness, D/29.2. Hammered, ground on periphery. Ring specific pressure, 8-9 lb. per sq. in. Ring width, 0.061 in.

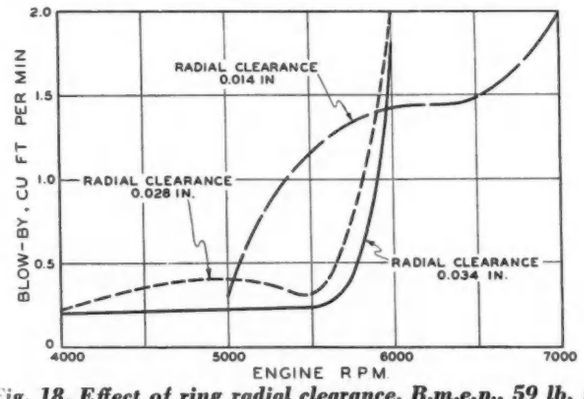


Fig. 18. Effect of ring radial clearance. B.m.e.p., 59 lb. per sq. in. Ring radial thickness, D/29.2. Ring specific pressure, 8-9 lb. per sq. in. Ring width, 0.061 in. Ring side clearance, 0.003 in.

Effect of Clearance Behind Rings

For each test the same piston rings were used, *i. e.*, having a mean radial pressure of 8 to 9 lb. per sq. in. and with the same gap clearance of 0.035 in., the side clearance being 0.003 in. Three pistons were prepared having different diameters at the bottom of the groove, so as to give radial clearances behind the ring of 0.034 in., 0.028 in. and 0.014 in., respectively, at atmospheric temperature. The results are shown in Fig. 18, from which it will be noted that there was little difference between the rings having a clearance of 0.034 in. and 0.028 in. and, in both cases, ring breakage occurred at 6000 r.p.m. With the small clearance of 0.014 in., blow-by increased above 5000 r.p.m., but did not reach the value obtained with the other clearances until a speed of 7000 r.p.m. had been reached, at which speed ring breakage occurred. It might be inferred that the effect of the restricted clearance behind the ring was to limit the amplitude of vibration of the ring, as in the previous series of experiments.

It is of interest to record that the length of the piece of ring which broke off was approximately 1 in. when

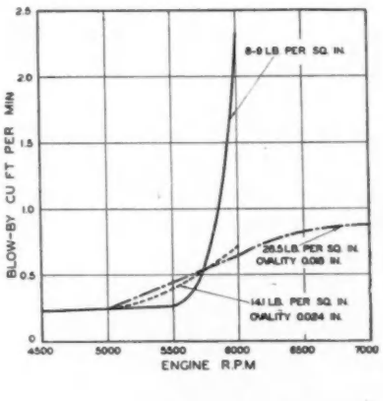


Fig. 19. Effect of ring pressure. B.m.e.p., 59 lb. per sq. in. Ring width, 0.061 in.

the back clearance was 0.034 in., ¼ in. when the back clearance was 0.028 in., and only ⅛ in. when the back clearance was 0.014 in.

Effect of Radial Pressure

These experiments were carried out with piston rings of 0.061 in., width, and having a side clearance of 0.003 in., but of the following radial pressures:—(*a*) 8 to 9 lb. per sq. in.; (*b*) 14.1 lb. per sq. in.; (*c*) 28.5 lb. per sq. in The results are as shown in Fig. 19, and indicate a rapid rise in blow-by above 5500 r.p.m. with the rings of 8 to 9 lb. per sq. in. pressure. With rings of 14.1 lb. per sq. in. pressure there was an increase in blow-by above 5000 r.p.m., but it did not reach the excessive value at 6000 r.p.m., which was obtained with the rings of lower radial pressure. The high-pressure rings (28 lb. per sq. in.) showed similar characteristics, and blow-by increased relatively slowly above 5000 r.p.m., reaching a value of about 0.8 cu. ft. per min. at 7000 r.p.m. These results, therefore, confirm the beneficial effect of high-pressure rings from the standpoint of blow-by control at high speeds.

Experiments on the single-cylinder water-cooled unit, already described, indicated that, with a poor ring in the top groove, excessive blow-by at high speeds could be largely prevented by a correctly functioning ring in the lower groove. For similar tests on the air-cooled unit, a bevelled ring was used in the upper groove, as other experiments described later in this report showed that it gave poor performance. The blow-by readings obtained with this upper ring and with a low-pressure ring in the lower groove are shown in Fig. 20, and indicate excessive blow-by above 5000 r.p.m. When a high-pressure ring (28.5 lb. per sq. in.) was substituted for the lower ring, the results, given in Fig. 20, indicate a somewhat higher blow-by at the lower speeds, but a definite control of blow-by at the higher speeds, it being possible to run the engine up to 6000 r.p.m., at which speed engine failure occurred owing to a big-end breakage. On the same graph are reproduced the results obtained with high-pressure rings in both upper and lower grooves, and it will be noted that over the whole speed range the blow-by was somewhat less than that obtained with a low-pressure upper ring and a high-pressure lower ring.

A correctly functioning lower ring was, therefore, able to control the blow-by produced by the misbehavior of an upper ring, and it is of interest to record that ring breakage of the upper ring did not occur up to the maximum speed of the test, viz., 6000 r.p.m.

The factor of "point pressure" or "ovality" has not yet been studied adequately in the present series of experiments, but the results of some comparative tests on rings having different ovalities are given in Fig. 21. One set of experiments was carried out with low-pressure rings (9 lb. per sq. in.) of 0.008 in. and 0.021 in. ovality, while the other comparison was made on high-pressure rings (17.4 lb. per sq. in.) of 0.003 in. and 0.030 in. ovality. The results do not indicate any appreciable improvement in blow-by control with rings of high ovality. It must, however, be admitted that there is a good deal of published evidence to the effect that rings of high point pressure are beneficial under certain conditions, and further experiments are in hand on a wide range of piston rings in order to study this variable much more extensively.

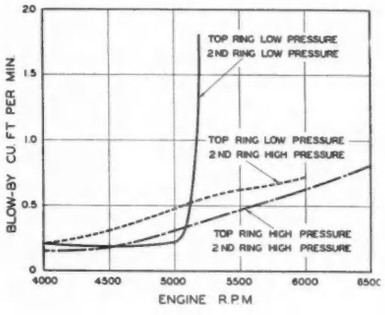


Fig. 20. Blow-by with different ring combinations. B.m.e.p., 59 lb. per sq. in. Ring width, 0.061 in.

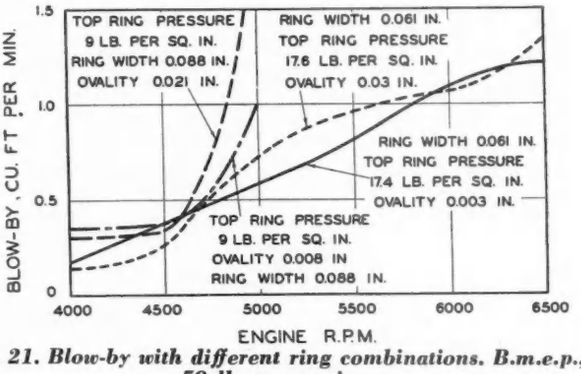


Fig. 21. Blow-by with different ring combinations. B.m.e.p., 59 lb. per sq. in.

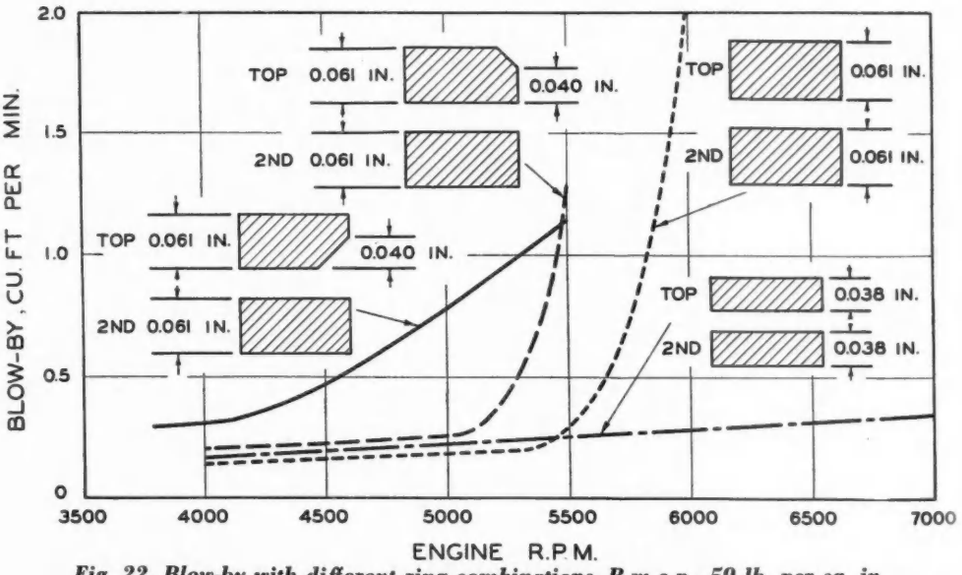
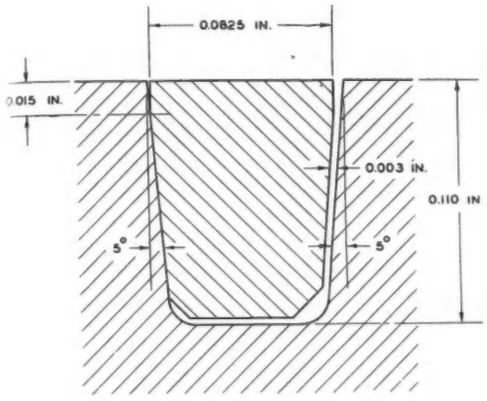
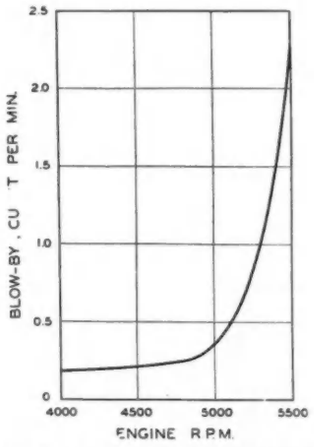


Fig. 22. Blow-by with different ring combinations. B.m.e.p., 59 lb. per sq. in. Low-pressure rings with a radial thickness D/29.2.





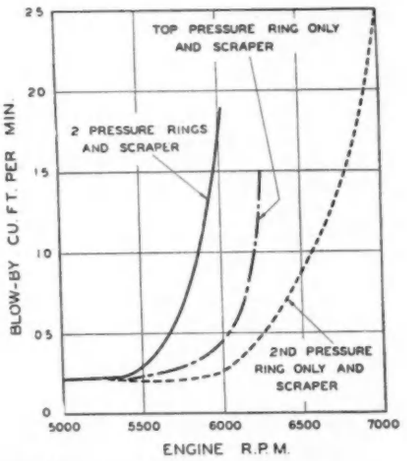


Fig. 23. (Left) Wedge-shaped ring. Fig. 24. (Center) Blow-by with wedge-shaped rings. B.m.e.p., 59 lb. per sq. in. Ring radial pressure, 9.6 lb. per sq. in. Ovality, 0.002 in. Fig. 25. (Right) Effect of number of rings. B.m.e.p., 59 lb. per sq. in. Ring radial pressure, 8-9 lb. per sq. in. Ring width, 0.061 in.

Tests on Bevelled Rings

Previous tests having shown the beneficial effect of reduced piston ring width, experiments were carried out to ascertain whether this benefit was attributable to the reduced bearing surface in contact with the cylinder wall, or to some other cause. A piston ring of 0.061 in. width and of 8 to 9 lb. per sq. in. radial pressure was bevelled so as to reduce the width of the bearing surface to 0.04 in., *i. e.*, approximately to that of the narrow rings which had previously given such good blow-by control. Fig. 22 shows the results obtained (*a*) with plain rings of 0.061 in. width; (*b*) with plain rings of 0.038 in. width; (*c*) with a bevelled ring in the top ring groove, the bevel being uppermost; and (*d*) with a bevelled ring in the top ring groove, the bevel facing downwards. The results indicate that bevelling the top ring had, in both cases, a detrimental effect, the results being inferior to those obtained with the plain unbevelled ring of full contact width. The results with the bevel facing downwards were particularly inferior. In can, therefore, be concluded that the good performance of a narrow ring is not attributable to the smaller bearing surface in contact with the cylinder bore, but to some other cause.

Effect of Wedge-Shaped Rings

The dimensions of the rings and grooves used in these tests are shown in Fig. 23, which indicates that the side clearance, when the periphery of the ring was flush with the piston lands, was 0.003 in. Such rings are widely used, as they constitute a very effective remedy for ring sticking, and it has also been claimed that they are a cure for blow-by, but the results of the present tests, shown in Fig. 24, were definitely disappointing, blow-by increasing excessively above 5000 r.p.m., and the ring broke into about five fragments adjacent to the gap.

Effect of a Number of Rings

The piston was normally fitted with two pressure rings and one scraper ring, and the blow-by results obtained with rings of 8 to 9 lb. per sq. in. radial pressure and 0.06 in. width are indicated in Fig. 25, blow-by increasing excessively above 5500 r.p.m. With the lower pressure rings removed, the results shown in Fig. 25 indicate an improvement in blow-by, *e. g.*, at 6000 r.p.m. the blow-by was reduced from 1.9 to 0.4 cu. ft. per min. The results obtained with the top pressure ring removed are indicated in the right-hand curve of Fig. 25, and are of particular interest as they indicate a marked improvement when operating on a single pressure ring in the lower ring groove. It was possible to operate the engine up to 7000 r.p.m. without ring breakage, although blow-by under these conditions was excessive.

Effect of Oil Viscosity

Comparative tests were carried out on two lubricants, one being a light mineral oil conforming to S.A.E. 20, while the other was a heavy compounded oil conforming to S.A.E. 50. The results, shown in Fig. 26, indicate identical blow-by readings with the two lubricants.

Similar tests were carried out with these two lubricants using the narrow rings of 0.038 in. width, which previous results had shown to give a fairly uniform blow-by up to 7000 r.p.m. The results showed that practically identical results were obtained with the two lubricants in this instance also.

Effect of Spark Advance

A series of tests was carried out at constant spark advances of 20 deg., 43 deg. and 62 deg., the normal fully advanced position for the magneto being 43 deg. The throttle was adjusted so as to maintain the same b.m.e.p. of 59 lb. per sq. in. throughout. The results, shown in Fig. 27, relate to the high-speed portion only of the blow-by characteristics as it was found impossible, for example, to run the engine with 62 deg. ignition advance at the lower speeds. The results indicate that the speed at which blow-by increased was higher with retarded ignition. Another way of expressing this result is to state that, at any given speed, the blow-by was higher the more advanced the ignition, *e. g.*, at 4000 r.p.m. the blow-by was 0.33, 0.6 and 1.17 cu. ft. with ignition advances of 20 deg., 43 deg. and 62 deg., respectively.

Composition of Blow-by Gases

As in the experiments on the water-cooled unit,

analyses were made of blow-by gases under various conditions, and the following Table gives some typical results, together with the rate of blow-by observed while the gas samples were being collected:

Blow-by cu. ft. per min.	*% CO*	*% CO_2*	*% O_2*
0.2	0.5	2.0	17.0
2.4	1.3	1.6	17.6
3.8	2.6	3.6	13.7
5.0	1.6	2.4	16.3

The above results do not indicate any systematic change in the composition of the blow-by gases with increase in blow-by, except to suggest that with high rates of blow-by, *e. g.*, over 2 cu. ft. per min., the CO content is higher than when the blow-by is small.

The above analyses are, in general, similar to those obtained on the water-cooled unit, and tend to confirm that the blow-by gases consist of air containing partial products of combustion.

Conclusion

A fairly complete summary of the conclusions reached in these experiments is given at the beginning of the report. Particular attention may, however, be called to those factors which have been shown to be beneficial in so far as blow-by control is concerned; these are (1) narrow rings, (2) high-pressure rings, and (3) reduced side clearance. All of these remedies necessitate, of course, some compromise. Thus, (1) and (2) involve an increase in wear. In this connection, cylinder wear experiments described in Report No. 8613 B indicate that, under the particular conditions described in that report, a reduction in piston ring width from 3/32 in. to 1/16 in. increased cylinder and ring wear by 20 per cent. Other experiments, described in Report No. 8585 B, indicated that an increase in ring pressure from 6 to 14.7 lb. per sq. in. resulted in higher wear to the extent of about 50 per cent. On the whole, the present experiments suggest that narrow rings of relatively low pressure are more effective than rings of high radial pressure. An additional point in favor of narrow rings of low pressure is that they are easier to fit without breaking or overstraining than are high-pressure rings.

Another result of considerable interest is that, on a high-speed engine, improved results are obtained by the use of a single pressure ring.

It is with some diffidence that the authors submit a new theory of "ring flutter" since they have not yet had the opportunity of testing it thoroughly in all its implications. Briefly, it is as follows: During the entire compression stroke, the piston ring is normally in contact with the bottom face of its groove, being forced thereto by the rising gas pressure acting on the upper side of the ring, while, in addition, the ring is forced outwards by gas pressure behind the ring. The latter induces frictional drag between the ring and the cylinder bore, which helps to keep the ring on the lower face of the groove. Just beyond top dead center there are, however, two forces which tend to make the ring move to the upper side of the ring groove, viz., frictional drag, which then acts upwards, and the inertia of the piston ring. This latter, expressed in terms of an upward pressure, amounts to as much as 40 lb. per sq. in. on a ring of 0.088 in. wide at an engine speed of 5000 r.p.m. The magnitude of the frictional drag at t.d.c. is unknown, but engine friction experiments suggest that it may be high. It is, therefore, suggested that, at a sufficiently high engine speed, the piston ring moves at t.d.c. from the lower to the upper side of the ring groove, which severs communication between the back of the ring and the combustion chamber, whereupon gas pressure behind the ring is relieved through the lower side clearance. It is reasonable to assume that no piston ring is normally in perfect contact with the cylinder bore, either due to imperfect running-in or to bore distortion, so that there is always some gas pressure tending to lift the ring from the bore, this being resisted by the pressure behind the rings. When the latter pressure is relieved, as described above, the ring may collapse, most probably near the joints where it is weakest and, since this collapse occurs under a pressure approaching that in the combustion chamber, it may occur with such violence as to break the ring in the region where the joints butt.

The escape of gas between the ring and the cylinder bore will, of course, tend to reestablish the pressure behind the ring, so that the ring may then be forced out against the cylinder bore.

While there are certain difficulties in reconciling this hypothesis with all the facts of observation, it accounts for the beneficial effect of narrow rings (this being largely due to their low inertia). Also, it explains the effect of engine load, of ring tension, and of badly run-in rings.

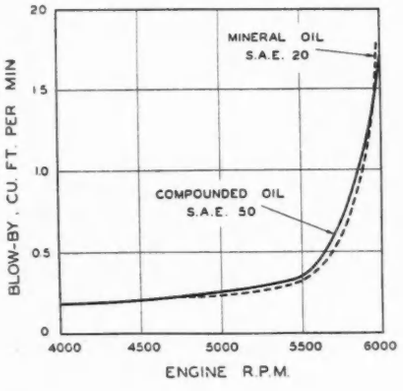


Fig. 26. Effect of oil viscosity. B.-m.e.p., 59 lb. per sq. in. Ring radial thickness, D/-29.2. Ring radial pressure, 8-9 lb. per sq. in. Ring width, 0.061 in. Ring side clearance, 0.003 in.

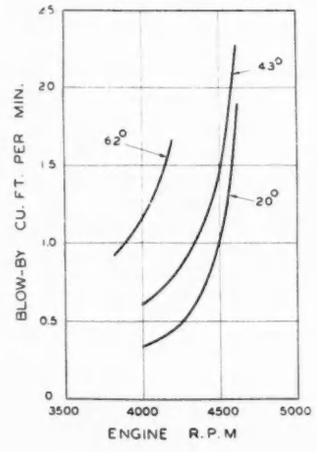


Fig. 27. Effect of spark advance. B. m. e. p., 59 lb. per sq. in. Ring radial thickness, D/29.5. Ring radial pressure, 9-10 lb. per sq. in. Ring width, 0.088 in.

AUTOMOTIVE INDUSTRIES

Just among Ourselves

THE Government Printing Office took care of the week-end reading of many an automoile company executive last week by issuing a 1076-page book incorporating data gathered by the Federal Trade Commission in pursuit of a Report on the Motor Vehicle Industry, ordered into being by Joint Resolution 594 of the third session of the seventy-fifth Congress. There was a time when textbooks on economics (and this report belongs in that classification) were the result of patient, protracted and pedestrian research growing out of the needs of scholarship and the public welfare. Now, it seems, an economic textbook is another of the utilities which can be conceived by the legislative branch of the government, gestated within the crowded womb of a government commission, and be born painlessly with a large litter of other material of the same sort.

Our first reading of the report leads to the conclusion that the Federal Trade Commission is headed by a group of somewhat reluctant witch-burners. The report is remarkably temperate in character. In some cases, the possible inferences from the data in the body of the report might have led to conclusions far more disturbing than those offered by the Commission in transmitting the material to the speaker of the House of Representatives. On the other hand, the mere availability of the report will be a constant reminder to Congress that "something ought to be done about" an industry which has been so voluminously documented. This is, perhaps, the most disturbing element of the report.

On the positive side, it is a pleasure to note that the Commission has produced a remarkably well organized study of the history, evolution and present character of the automobile industry. The report will undoubtedly be one of the two or three bench marks from which all future studies of the industry are planned. The table of contents of the report contains 19 pages. Even reading the subject headings on these pages is sufficient to give a view of the magnitude and scope of the motor vehicle industry heretofore unattainable on a documented basis.

There is material in the book which can be studied with profit by every responsible executive in the industry. There is much material which could only appear in a book of which the authors were armed with the authority of the Federal government to pry into files and ledgers. There are data which are too old to be of much present value. There are data which have never seen the public light before, and many that are all too familiar. From any standpoint the report is a valuable addition to knowledge of the industry. As a corollary to a philosophy of government, however, it leaves much to be desired.

More and More Millions . . . . .

Already the Number One show of the motor vehicle industry, the Associated Service Industries Show, which has just closed in Chicago, assumed new importance with the disclosure of the fact that motor vehicle registrations in the United States total nearly thirty and a half million units. To the service industries a climbing total of registrations means a positive gain in market potential roughly proportional to the registration increase. Because the maximum age of most of the vehicles in use now falls within the decade within which complete registration data are available, it is possible to make very accurate estimates of the number of each make in use by age groups. We are rather proud of having pioneered advance estimating of total registrations and age of cars in the replacement market. Anyone who has an interest in either set of data and has missed its appearance in the magazine is invited to write to us about it.

Just One Day— and Then Tomorrow

Some day when his other editorial responsibilities are at a standstill for a year or two, the conductor of this page intends to undertake the compilation of an encyclopedia of Christmas. It has been done before, and it will be done again, and the result of all the efforts will remain as it does now—a pathetic reminder that none could, in a lifetime, tell the whole story of One Day in the life of the world.

But the virtue of the effort, it is hoped, will lie in the fact that unless such an enterprise were undertaken, such quaint homilies as appear below would be buried in library dust.

> "Cheer up, sad heart, crown Christmas bowls,
> Banish dull grief and sorrow,
> Though you want clothes, you have rich souls,
> The sun may shine tomorrow."

That, with a few differences in spelling, was written by one *Jacobite* about 1652.

Please consider it as a personal greeting from me to you.

—HERBERT HOSKING.

EDITORIALS

Ryerson Develops A New Steel

Announcement has been made by Joseph T. Ryerson & Son, Inc., Chicago, of the development of a new H.T.M. alloy steel which has the characteristic of being machinable under ordinary shop conditions after being hardened to more than 450 Brinell. The new steel is a chrome-nickel-molybdenum alloy, analysis carbon 0.35 to 0.45, minimum manganese 0.50, minimum nickel 20 per cent, minimum chrome 0.90, and minimum molybdenum 0.40. The alloying elements are so balanced that the steel will develop a high degree of hardness with either oil quench or air cooling.

The steel was developed for applications when a very high tensile, high-hardness, and deep hardening alloy is desired and where in large sections uniformity of hardness from the surface to the center is desirable. With a suitable type of heat treatment, sizes as large as 10 in. rounds can be made to show uniform hardness throughout the entire cross section. Parts such as cams, rollers, and gears can be rough machined, then heat treated to desired hardness, then finish machined, eliminating any grinding or danger of distortion due to heat treatment.

The steel is said to be particularly resistant to impact and shock at sub-zero temperatures. It is also suitable for bolts used at high temperatures. Tests indicate that at 1000 deg. it will show about 100,000 lb. per sq. in. tensile strength, 85,000 lb. yield point, 25 per cent elongation in 2 in. and 79 per cent reduction of area.

This alloy is carried in stock under the name of Nikrome "M" which has the following typical minimum physical properties: Tensile strength, 110,000 lb. per sq. in.; yield point, 90,000 lb. per sq. in.; elongation, 16 per cent in 2 in.; reduction of area, 47 per cent; Brinell hardness, 240-265.

TYPICAL PHYSICALS ON 1 IN. ROUND SAMPLES OF RYERSON HTM ALLOY STEEL

Draw	T.S	Y.S.	Elong. in 2 in.	Red.	Brinell
Air cooled from 1650 deg. Fahr.					
As quenched	311,000	159,000	0.5	1.85	578
700	241,000	215,000	11.5	37.0	477
900	205,000	184,000	13.5	42.0	415
1100	158,000	137,000	14.0	53.0	321
Oil quenched from 1550 deg. Fahr.					
700	237,000	207,000	11.5	44.0	461
900	205,000	194,000	13.0	44.0	415
1100	158,000	142,000	18.0	58.0	321

Produces a New Composite Metal

A machine which produces a new composite metal with wearing qualities claimed to be better and more lasting than those of competitive materials, such as tin terne and galvanized steel, has been licensed for manufacture by the United Engineering and Foundry Co., Pittsburgh, Pa. The license has just been granted by R. E. Kinkead,, a Cleveland engineer and consultant in welding.

The new material is ordinary steel with the surface alloyed by addition of chromium and nickel. It can be produced within predetermined specifications and is capable of being made in thicknesses comparable with paper, or 0.010 in. The process is also controllable for production of various alloys. Pickling, shot blasting, cold reduction, polishing or other operations may be carried out at costs which are customary with ordinary materials.

The machine utilizes the Lincoln "Electronic Tornado" process of automatic carbon arc welding.

Research On Cylinder Irons

We understand that a metallurgist now undertaking an important research project on cylinder irons is going to recommend that a routine test for structure be added to the spot checks on pouring samples now employed in high grade automotive foundries.

Heat Treating Electrical

Development work on a new method of heat treating metals by electrical induction has been completed by Budd Induction Heating, Inc., subsidiary of the Budd Wheel Co. The process, which has been tested and proven in production at the Budd Detroit plant, makes possible the heat treatment of inside diameters of metal cylinders from 2 to 7½ in. and lengths up to 30 in. with present equipment. A wider range of sizes will be made available as required.

In hardening inside diameters in which the treated area is of considerable length, such as engine cylinders, a retracting type head, which heats the material by electrical induction, is used. This is drawn evenly through the cylinder, followed by a water quench.

On one of the machines now in regular operation, a "one-shot" type of head is used to harden the bore of automobile hub forgings, thus making the roller-bearing race an integral part of the hub. In this application, the treated area is brought to a hardness of 58-64 Rockwell "C." It is claimed that nearly 2,000,000 pieces have been turned out on these machines during the past three years without a failure being reported.

The method of heat treatment by induction is applicable to all ferrous materials of suitable analysis. This includes any material which may be hardened, drawn, tempered, annealed or normalized by methods in general use. Gray iron—such as is used in engine cylinder blocks, cast steel pipe, cast-iron, and other materials of simplified analysis also are subject to the process.

In materials containing "free" or uncombined carbon, recombinations of this carbon at a greatly accelerated rate can be accomplished through this method of induction heat treatment, markedly increasing the "hardenability" and strength of the area treated. The grain size of the treated material may be made consistently smaller, which is considered an advantage in most applications as improved physical properties can be developed in this manner.

The process permits redesign of parts with lowered weights and costs in cases where integral localized heat treatment may favorably alter the metallurgy of the casting or forging to the point where a predetermined

Materials

Metals by Induction

I.D. area of the original casting or forging becomes a hardened wear resisting surface.

Cited as an important feature of the process is the fact that the outside diameter, and all other unhardened areas, can be machined after heat treatment of the inside diameter of the bore. As the depth of the hardened area is accurately controlled, the area which can be machined after the bore has been hardened can be very precisely determined. Sections of the

An automobile hub in place in the new induction heat treat machine developed by Budd Induction Heating, Inc., subsidiary of the Budd Wheel Co.

bores which need hardness can be treated accurately to produce this quality, leaving tough machineable metal in all other parts of the hub, cylinder, sleeve, or other part under treatment. Further local heat treatment is also possible after machining.

Because of the short heat cycle employed, the whole hardening operation is performed in one to three seconds and decarbonization does not occur.

It is stated that the method makes possible extremely accurate control of area, depth and degree of hardness. Beyond this, a control system which operates automatically insures uniformity of hardness throughout the treated area, uniformity of area treated, and uniform depth of areas hardened. Depth of the area hardened can be varied from thirty thousandths of an inch to ⅛ in. or more.

Calendered Sheets of Plastic Material

Calendered sheets of "Vinylite" plasticized resins which are said to have many of the advantages and few of the disadvantages of leather and rubber are a recent development of the Carbide & Carbon Chemicals Corp., a unit of Union Carbide & Carbon Corp. These sheets, which can be supplied colorless or in transparent or opaque colors, offer possibilities for applications heretofore removed from the plastics industry.

The new, highly plasticized materials will withstand folding and repeated flexing. Elongations up to 250 per cent, with a tensile strength of 3000 lb. per sq. in. are readily obtained. The sheets are very tough and when stretched appreciably will return slowly to their original dimensions. High strength permits use of relatively thin sections.

Regarding permanence, these materials will not oxidize or crack, nor are they affected by mold or mildew. It is further claimed that they are completely resistant to water and perspiration, and will not discolor or develop any odor from moisture absorption. Depending upon the plasticizers used, they can be made highly resistant to oils, greases, gasoline and alcohol. The plasticized sheets are thermoplastic which permits making a permanent bond by means of a rapid heat-sealing operation.

The sheets are made in thicknesses ranging from film, approximately 0.003 in. in thickness, up to almost any thickness desired. Stocks in thicknesses from 0.003 to 0.090 in. are available in essentially continuous lengths.

Powdered Form of Synthetic Rubber

A manufacturer of synthetic rubber-like material reports that it is developing a powdered form of its product that may be sprayed on metal with the Schori Gun. The powdered synthetic is said to stick to metal like glue, lay evenly on the metal and form a continuous protective coating.

As compressed air shoots the powdered synthetic rubber-like material through the Schori Gun, a gas flame fuses the material and causes it to flow together on metal surfaces. Upon cooling, the synthetic rubber-like powder forms a continuous film. Work now in progress is said to indicate that this film will be resistant to oils, greases and many acids and solvents.

New Literature on Materials

A pamphlet published by Estox Products Co., New Haven, Conn., describes the company's new product called "Metastrip," which is intended for the stripping of baked enamels, varnishes, lacquers, paints, japan, including the latest synthetic finishes, from metals such as steel, zinc, alloys, etc.

P. R. Mallory & Co., Inc., Indianapolis, Ind., has issued two leaflets which deal, respectively, with "Silver-Faced Base Metal Backed Contracts" and "Non-Ferrous Alloys."

Dispersion Hardening of Nickel Alloys

Messrs. N. B. Pilling and A. M. Talbot of the International Nickel Co., Inc., Bayonne, N. J., have written a very comprehensive paper on the dispersion hardening alloys of nickel and iron-nickel-titanium.

The paper develops the subject by presenting, (1) a condensed summation of pertinent information dealing with the dispersion hardening of nickel; (2) a resume of the important characteristics of the few dispersion hardening high nickel content alloys which have been commercially developed; (3) the results of an experimental search for effective dispersion hardening in the iron-nickel series as a base; (4) an elaboration in detail of the application of titanium as a dispersive to the hardening of two important iron-nickel alloys.

MEN and MACHINES

BINS on wheels are the vital factor in a clever, simple scheme which facilitates the supply of small lathe components to sub-assembly lines in the Monarch Machine Tool Co.'s plant at Sidney, Ohio. The idea might be applied very easily wherever a wide variety of different units are assembled in small lots.

Lathes are usually assembled at the Monarch plant in groups of less than 25 units of one size and type at a time, hence no standard mass production method of constantly feeding the same parts to the same work-bench day after day is possible. The conventional method of solving such a materials handling problem is for the stock room to bring a supply of parts to each assembler and pile them up on his work-bench.

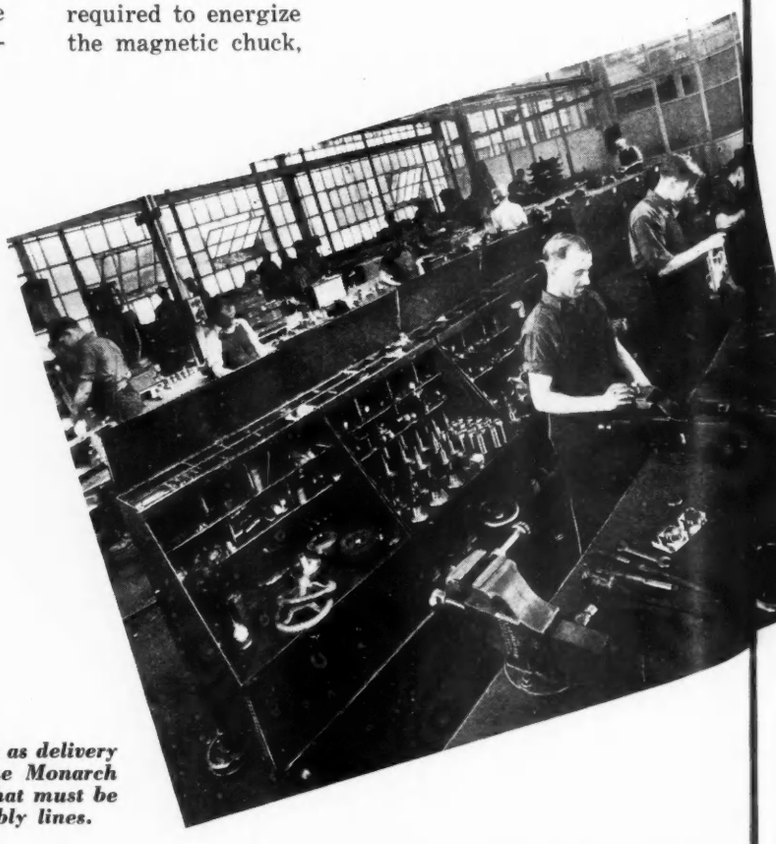
There are a number of annoying problems associated with the conventional system. Time is lost in transferring parts from truck to bench. Parts are spread around on benches and in miscellaneous boxes and pans. Some parts may be mixed in with other items. There is always the possibility of small pieces rolling off and getting lost behind or under benches. It is also practically impossible to keep the parts clean or free of scratches.

The forementioned headaches are obviated at the Monarch plant by the use of specially designed cabinets that serve both as delivery trucks and storage units. These parts-assembly trucks, loaded in the stock room with the supply of detail parts conveniently placed in handy compartments, are wheeled to positions alongside the workmen's benches in the assembly department and left there.

Parts are only removed from the cabinets when they are needed. Small items, such as pins, washers and bolts and nuts, are kept in handy 6 by 6-in. bins on top of the trucks. There is a hinged cover on the top bins and all compartments are thoroughly cleaned out each time the unit is re-loaded in the stock room.

The units are of all-welded sheet steel construction and consist of nine vertical compartments of different sizes, topped by 12 horizontal 6 by 6-in. sections. At the base is a 15 by 36-in. compartment 27 in. deep for extra large parts and for storage of the sub-assemblies when they are completed. The units are 4 ft. high, and are narrower at the top than at the bottom so that all levels can be seen from above.

AMONG the recent new offerings of the machine tool builders are a precision surface grinder and a universal cutter grinder, both products of Continental Machines, Inc., Minneapolis, Minn. The same basic unit, with ball bearing work table, is used for the cutter grinders as well as for the surface grinders. Inside the base there is room to accommodate the head and fixtures not in use. Change-over time from surface grinding to tool grinding is a matter of a minute or two. For surface grinding, a balanced built-in motor driven spindle is provided. The spindle is a completely inclosed unit, ball bearing mounted, and has a very long support. The one-horsepower motor eliminates the need for belt drives and idler pulley. Special bearing construction is said to eliminate end play of the spindle. The wheel spindle is so mounted that it may be set at any angle up to 30 deg. No electric current is required to energize the magnetic chuck,



Specially designed cabinets that serve both as delivery trucks and storage units are used by the Monarch Machine Tool Co. to handle small parts that must be continually supplied to small-lot assembly lines.

Bins on wheels that facilitate assembly; a press with inclinable mounting; another with new features and a versatile grinder are among the developments of the month

inasmuch as it contains a series of permanent high-power magnets.

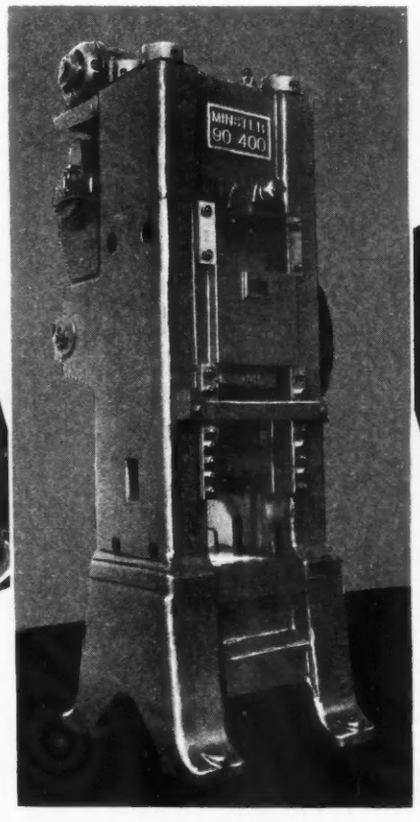
A feature of the "Doall" grinders is a cold-light method of illuminating the work. The back edge of the wheel cover forms a reflector which carries a 9-in. "fluorescent" lamp. This tubular lamp gives off a cold light thus eliminating the possibility of heating and distorting the work from localized high temperature lighting.

SEVERAL new developments in presses have been announced, including new models in the 90 series of knuckle joint embossing presses built by The Minster Machine Co., Minster, Ohio, and the availability of inclinable mountings for the 645 series of high production presses manufactured by E. W. Bliss Co., Brooklyn, N. Y.

Eight sizes, all of four-piece steel tie rod construction, comprise the Minster Machine Co. line. The machines range in capacity from 150 to 1500 tons. The 600-ton and larger presses have the Minster air operated combination multiple disk clutch and brake as standard equipment. This drive unit is optional equipment on the smaller presses in lieu of the positive clutch.

The knuckle assembly on the Minster machines is equipped with oversize alloy steel knuckle pins bushed with hardened and ground steel bushings. Each knuckle bearing is connected to a high-pressure continuous circulating oil lubrication system and in addition to individual bearing lubrication a cascade of oil flows over the knuckle assembly. The manufacturer points out that through the knuckle action a dwell is obtained at the bottom of the stroke which makes this type of press ideally suited for coining, embossing, sizing, heading, heavy stamping, cold forging and similar operations where a delay with high tonnage is required to permit metal to flow or set.

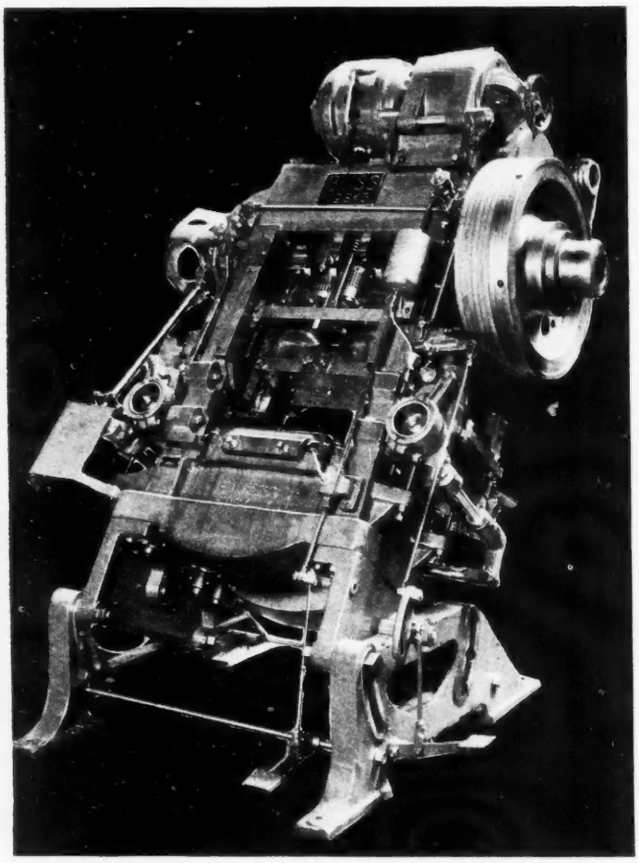
The Bliss inclinable mounting is a special feature which allows the machine to be operated in any one of three optional positions. A press so equipped can be used for work which is blanked through the dies and bed while the press is in an upright position. It can also be used for work that is either ejected by the bar knockout or is returned to the surface and discharged by gravity while the press is inclined. Bolster and clamping cap are so designed that the dies are easily set and tried out without returning the press to the vertical position.



One of the new models in the 90 series knuckle joint embossing presses built by the Minster Machine Co.

The new "Doall" grinder, product of Continental Machines, Inc., which may be set up as a universal cutter grinder or as a precision surface grinder.

OTHER announcements of new offerings which have been submitted to *Men and Machines* within the past month are as follows: Addition of two



One of the No. 645 series of high production presses manufactured by E. W. Bliss Co. which are now available with inclinable mountings. The machine shown is designed for 65 tons and has an operating speed of from 100 to 300 strokes per min.

new sizes, designated as Nos. 16 and 11, to the line of precision threading machines built by the Geometric Tool Co., New Haven, Conn. The No. 16 will cut threads up to 1 in. diameter in National Coarse Thread Series, sizes up to 1½ in. in fine pitch threads. The No. 11, although intended primarily for small diameter fine pitch threads up to 5/16-in. diameter, may also be used on finer pitches up to 9/16-in. diameter. The latter is a bench type machine. . . . The Hisey-Wolf Machine Co., Cincinnati, Ohio, has incorporated a number of improvements in its infinitely variable speed buffing and polishing machine. Spindle speeds, which are variable from 1000 to 3500 r.p.m., can be changed while the spindle is in action and can also be changed while the machine is actually under a working load. Only 10 sec. are required to change speeds from extreme low to extreme high, or vice versa. A speed dial plate in front of the machine is direct reading, indicating the r.p.m. of the spindle. . . . Pier Equipment Mfg. Co., Benton Harbor, Mich., has added two new models to its line of Ace spot welders used for spot or projection welding, and, with suitable fixtures, for butt welding. They are both 50 kw. in size, one motor-driven and automatically operated and the other manually operated by means of a swivel-jointed treadle. Both have added refinements, such as recessing automatic trip control and timing adjustment. Four throat depths are available and the lower horn may be adjusted to provide spacing up to 15 in. on standard welders. . . . Wickes Brothers, Saginaw, Mich., recently built an extra heavy duty automatic center drive lathe for machining heavy aeroplane and Diesel type crankshafts. The lathe has hydraulic feed with automatic work cycle and the operation is entirely through the electrical push-button station. Both headstock and tailstock are movable on the bed for accommodating different lengths of crankshafts. The rear tools are mounted on inverted cross slides which are carried in the back tool housing in order to withstand the thrust on the rear tool bits which is upward. Main drive is by means of a 40-hp. adjustable speed direct current motor through multiple vee-belts to an inclosed gear reducer. A separate 7½-hp. motor is used to drive the hydraulic unit. Forced feed lubrication is provided throughout. The center drive gear is mounted on large tapered roller bearings and totally inclosed in a housing to prevent the entrance of chips and dirt. A very large opening is provided in the center drive gear in order to facilitate the loading and unloading of the cranks.—H. E. B. JR.

Publications Available on Machine Tools

The Warner & Swasey Co., Cleveland, has begun a new service to *turret lathe* operators with publication of an informative four-page organ called "Blue Chips."*

Heavy slip roll forming machines built by the Niagara Machine & Tool Works, Buffalo, N. Y., are described in the company's latest bulletin No. 77-B.*

Cutting speed conversion tables showing the r.p.m. required for turning bar stock at surface speeds of 90 to 550 f.p.m. with Kennametal steel-cutting carbide tools have been prepared by the McKenna Metals Co., Latrobe, Pa.*

A folder giving details and dimensions of the Erickson Steel Co.'s new *collet chuck* designed for close accuracy on drilling and end-milling work has been issued by the Cleveland company.*

A bulletin published by the Air Reduction Sales Co., New York, describes the company's Airco No. 10 planograph, a *gas-operated cutting machine* designed for cutting straight lines, rectangles, circles and irregular shapes from ferrous metal of any thickness within the present practical limits of the cutting torch.*

A brochure prepared by *W. F. & John Barnes Co.*, Rockford, Ill., traces developments in machines built by the company "Since 1872."*

The machining of copper and its alloys is the subject of the latest book published by the Copper Development Association, Thames House, Millbank, London.

Bulletin IV-7 issued by the New Departure Division of General Motors Corp., Bristol, Conn., describes a modern application of *precision ball bearings* to a horizontal boring and milling machine headstock.*

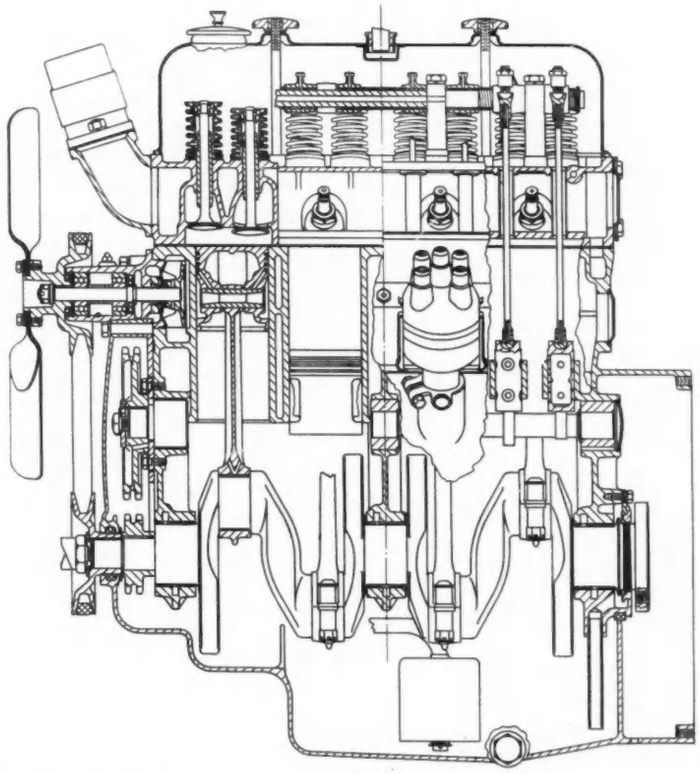
Three new bulletins describing the H&G *insert chaser die heads* manufactured by the Eastern Machine Screw Corp., New Haven, Conn., are as follows: No. 10 illustrates briefly the different styles of heads that are available for different classes of work; No. 11 covers insert chaser die heads for rotary spindles; and, No. 12 covers insert chaser die heads for turret lathes and hand screw machines.* (*Turn to page* 642, *please*)

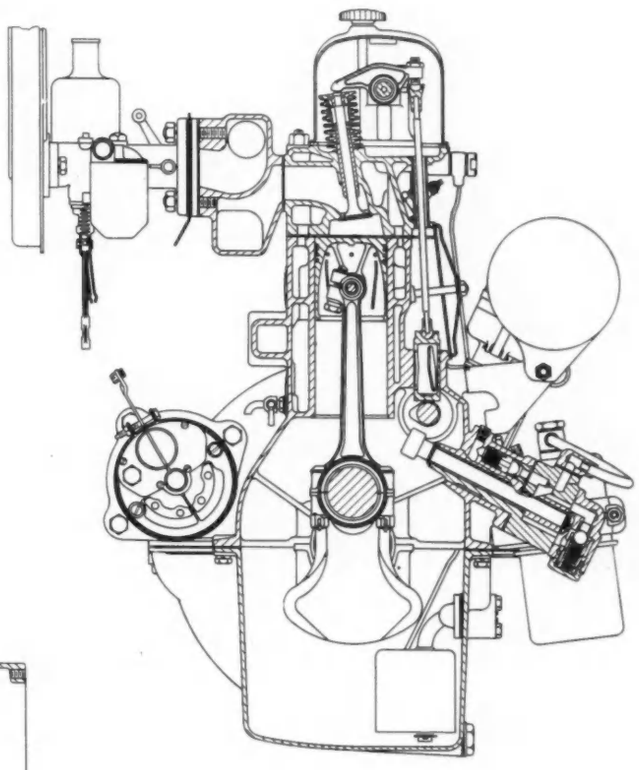
MORRIS TEN-FOUR SERIES M ENGINE and TRANSMISSION

Longitudinal and transverse sections of the engine

Displacing a model unchanged, apart from details, since 1932, the Series "M" Morris Ten-Four engine (63.5 x 90 m. m.) has a shorter stroke than the superseded type, giving it a piston displacement of 1140 c.c. as compared with 1292 c.c.; but compensating for this it has overhead in place of side valves and with a compression ratio of 6.5 to 1, it develops approximately 35 b.hp. at 3800 r.p.m., which is somewhat more than the earlier engine.

The three bearing crankshaft is counterweighted and has journals of 2 1/16-in. diameter and 1¾-in. diameter pins. Bearings are steel-backed white metal, those of the big-ends being of the full-ring type. Connecting rods are of steel and pistons of low-expansion aluminum alloy, tin-coated, with two pressure and two oil control rings. The combustion space, with pushrod operated valves slightly inclined, is offset from the cylinder axis and lozenge-shaped in plan with its length considerably greater than the cylinder bore. Inlet valves are of larger effective diameter than the exhausts, the latter being approximately 1 in. and the former 1⅛ in. Cylindrical cam followers

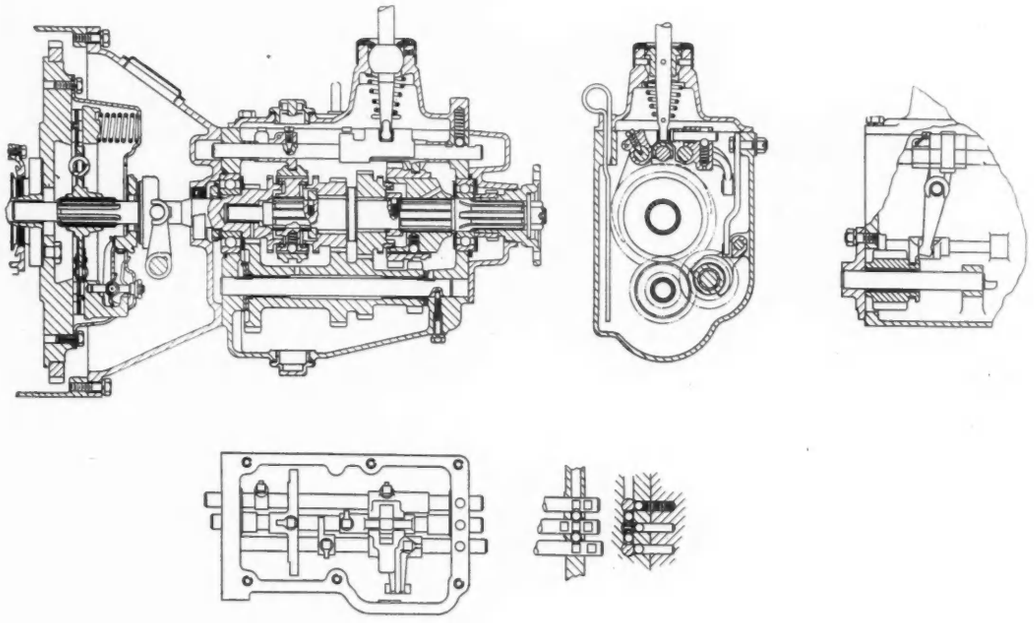




Description and sectional views of the transmission on the next page

MORRIS TEN-FOUR SERIES M ENGINE and TRANSMISSION

Details of Transmission



are of chilled cast iron in guides integral with the cylinder block. Only the top half of the crankcase is unit-cast with the block, the lower half with oil sump being a separate iron casting, though the crankshaft bearings are supported by the top half alone.

With duplex roller chain drive, the camshaft has three bearings and includes two helical gears, one for the unsubmerged gear type oil pump and the other for the ignition distributor, which has centrifugal timing control.

A triangulated belt drive from the crankshaft serves for the generator and combined fan and water pump shaft, the latter having two ball bearings and a carbon ring gland. A thermostatic valve is fitted without bypass.

The carburetter is a horizontal S.U. with intake balance pipe, hot-spot and interconnected throttle and starting mixture control. The combined air cleaner and silencer serves also as a fume extractor by having a connection with the interior of the overhead valve cover. Fuel feed is by electro magnetic pump.

Oil circulation under pressure is carried to the main and big-end bearings, camshaft bearings and overhead valve gear. An external pressure filter is provided additional to a cylindrical gauze filter in the sump. There is a non-adjustable relief valve as a unit with the pump, and a second one, also integral with the pump, to protect the external filter.

The electrical equipment is a 12-volt system with ventilated generator having compensated voltage control.

This engine is used in combination with a single-plate dry clutch with cushioned hub and single-point adjustment and a four-speed transmission with synchromesh on second, third and top, in place of the three-speed transmission of the superseded Ten-Four car. Gear ratios are: 1st, 3.807; 2nd, 2.253; 3rd, 1,506; top direct (5.29-in. rear axle) and reverse 3.807 to 1.

PRODUCTION LINES....

National Standards

A comprehensive discussion of national standards of measurement, noting historical development and present status, is found in the September issue of *Industrial Standardization*. The article comes from the pen of Dr. Lyman J. Briggs of the Bureau of Standards. It should be of great interest not only to technical and scientific men but to production executives as well since it touches so intimately the standardization of gages and other precise measurement devices essential to the manufacture of interchangeable parts.

Welding Screens

A method of making strong joints in wire screen, with mesh as fine as 76 to the inch, is described in *Oxy-Acetylene Tips*, October, 1939. First requirement is a suitable jig, the simplest being composed of three pieces—a heavy base plate and two short pieces with beveled edges. The joint is made with an oxy-acetylene torch using silver solder. By following the simple instructions given in the article, it is claimed that it is possible to produce strong joints scarcely perceptible to the eye.

On Technology

Succinct but packed with basic information is a brochure "Men, Methods, and Machines" just issued by the American Management Association. As a commentary on the subject of technology and its impact on labor and the social fabric of our economy, it is one of the finest contributions we have had the privilege of reading. We urge a wide reading of this study not only on the part of people within the industry but in a much broader sphere by educators, legislators, and politico-economists whose viewpoint must needs be sharpened by a look behind the scenes.

Flame Hardened

Although the oxy-acetylene flame has been widely used for hardening wearing surfaces, it's news to find the torch applied for hardening of a huge alloy cast-iron die. This die weighs about a half-ton and is used for stamping motor truck hangers. You can read the whole story in *Oxy-Acetylene Tips*.

Well Cooled

An independent outfit is working on the development of a unique clutch which, they claim, is simpler and less expensive than conventional clutches. For one thing, the entire clutch mechanism including the plate is housed within the flywheel. It has less parts than a conventional unit due to the use of hairpin springs in combination with a special system of levers. Chief talking point from service standpoint is generous provision for air cooling—drawing air through louvers in the flange of the flywheel, exhausting through slots in periphery of the rim on each side of the disc.

Loses Ground

According to careful estimates made by the National Machine Tool Builders' Assn., at their last annual meeting, there is an annual attrition of five per cent in the number of skilled workers available in the metal trades. This figure was quoted by way of indicating the serious need for apprentice training. Here is a problem that concerns the automotive industry and deserves serious attention at the present time.

Better Finish

Beyond doubt the ideal of better surface finish has received so much momentum as to demand unusual attention from this time out. Equipment stressing better finish possibilities, made by a number of manufacturers, was groomed for first showing at the National Machine Tool Show in Cleveland. In addition, we know of several manufacturers who have been working on special machinery and who may be ready with their announcements before the year is out.

First Aid

One of the most interesting service items to come over our desk is the lead article in the November issue of *Oxy-Acetylene Tips*, dealing with a simple method of repairing damaged or broken die-cast radiator grilles. Apparantly a good repair job can be effected by the use of half-and-half solder applied directly on the chromium plate, using a special phosphoric acid flux. The job is done with a controlled oxy-acetylene flame. This may be worth attention-calling in some of your service bulletins.

New Electrode

By fortuitous circumstance we have learned of the availability of an entirely new form of plating electrode which should make a big difference to those concerned with bright nickel plating. It is a "rolled carbon anode" whose chief attribute is complete and precise uniformity of structure which, after all, is the basic ingredient in good nickel plating.—J. G.

Gasoline Engine

By Hector Rabezzana, Stephen Kalmar and Alfred Candelise*

The variables controlling the effective reaction velocity can be divided into two groups. The first comprises all variables acting before the mixture is ignited; the second, the variables affecting the reaction during the process of combustion. Fig. 19 shows the correlation of all factors.

The factors in the first group include the speed of the mixture entering the chamber (induction system, piston speed), the mixture ratio in the chamber at the closing point of the intake valve which, of course, includes the exhaust gases trapped from the previous cycle, the turbulence level of the mixture during intake (piston speed), and additional random turbulence originating during compression due to chamber contour. As a combined effect of all these factors, the general condition of the mixture at the instant of ignition determines what we may call the "fundamental reaction velocity." If the condition of the mixture were uniform throughout the chamber, and if, moreover, it remained in its unburned portion, the same as at ignition, we could expect a constant reaction velocity during the whole combustion process.

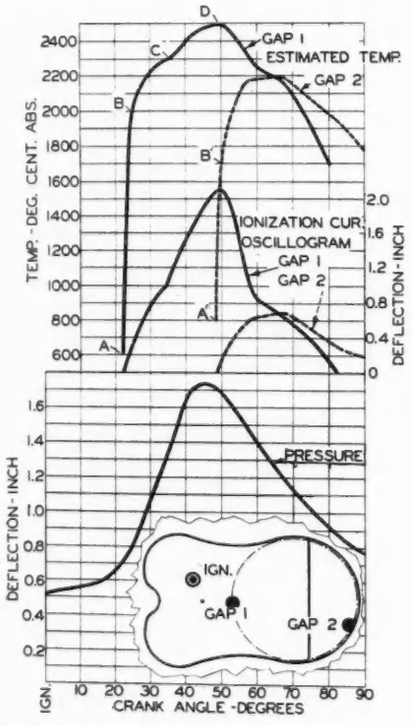


Fig. 18 — Ionization current records for two points in combustion chamber.

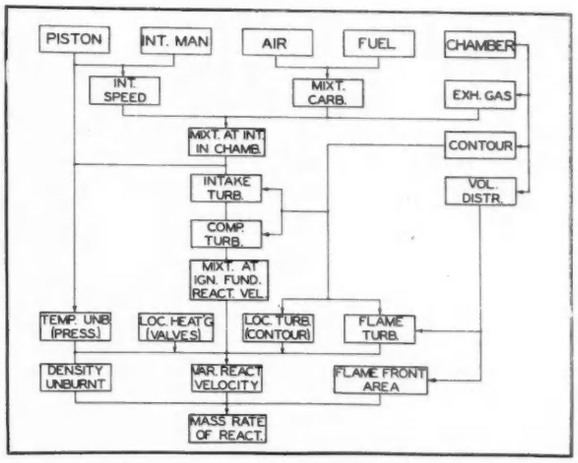


Fig. 19—Interrelation of factors affecting reaction velocity and mass-rate of reaction.

In reality, the state of the unburned mixture during the combustion process at any given instant varies from point to point in the chamber (local heating, local turbulence) and also, for the same point in the chamber, it varies from instant to instant. Responsible for the variation in reaction velocity during the combustion process are the factors in the second group: Temperature of the unburned mixture due to compression of unburned mixture during combustion, local heating effects in the chamber by the valves, for instance; local random turbulence caused by the chamber contour, and, finally, turbulence induced by the mass movement of the unburned charge immediately ahead of the flame front (flame turbulence).

The effect of these variables on the reaction velocity cannot be evaluated directly, as the reaction velocity itself can be measured only indirectly by its effects, pressure and flame. The relations between pressure, reaction velocity, and flame velocity are expressed as follows:

From the expressions for V_t, L, l (Equation 8 and foll.).

$$\frac{S}{S_r} = \frac{V_y}{\frac{V_t}{c} + v_b} + 1 \quad \ldots\ldots\ldots \quad (9)$$

in which $c = Y^{\frac{1}{n}} - 1$

A straight-line relation exists between S and S_r, if, for the cases to be compared, V_t, V_y and Y are the same. Otherwise the effects of these three variables have to be considered. Fortunately, however, under normal operating conditions, their combined effect upon the relation of S and S_r does not exceed 10 per

* All of the co-authors are of the AC Spark Plug Division, General Motors Corp., Flint, Mich.

Part Two *Part One appeared in November 15, issue of Automotive Industries*

Combustion

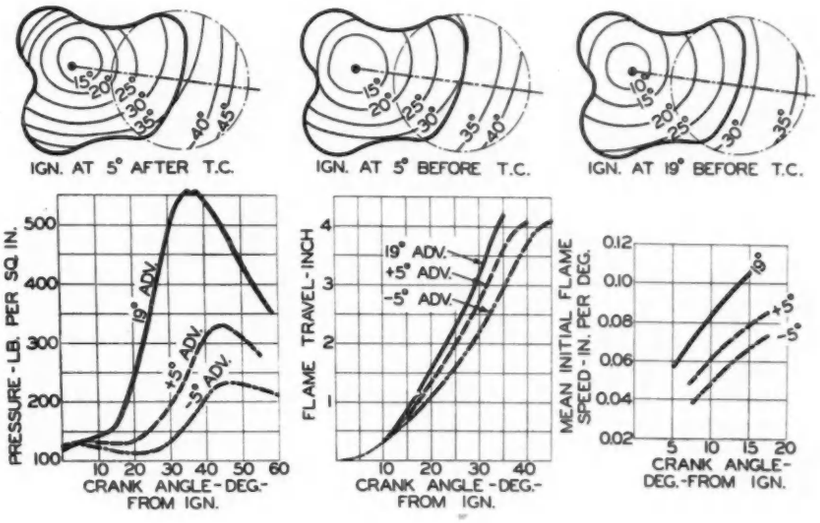

IGN. AT 5° AFTER T.C.
IGN. AT 5° BEFORE T.C.
IGN. AT 19° BEFORE T.C.
PRESSURE - LB. PER SQ. IN.
19° ADV.
+5° ADV.
-5° ADV.
CRANK ANGLE - DEG. - FROM IGN.
FLAME TRAVEL - INCH
MEAN INITIAL FLAME SPEED - IN. PER DEG.
CRANK ANGLE - DEG. - FROM IGN.

Fig. 21—Effect of spark advance on pressure, flame propagation and initial flame speed.

cent. Therefore, in the following the effect of the various factors upon the reaction velocity will be judged by the behavior of the flame velocity. At the same time, if possible, the pressure-time relations also will be analyzed, to show the effect of the reaction velocity.

1—MIXTURE RATIO. The three flame diagrams and p-t records in Fig. 20 were obtained from the single-cylinder test engine at 1500 r.p.m., full load, 11 deg. adv., with fuel consumption settings corresponding to L.M.P. (leanest for maximum power), 16 per cent lean, and 20 per cent rich mixture. It is evident in all three cases that the flame speeds on the maximum travel line differ mainly during the first inch of travel; beyond that point there is not much difference in speed. At this initial stage, the rich mixture burns somewhat faster, the lean mixture considerably slower than the L.M.P. mixture (see flame-displ. curves). The generally accepted opinion that a lean mixture burns "slow" throughout the process may be true for bombs, where the mixture is stagnant, or for lean mixtures beyond, say, 16:1 A-F ratio, but in a range of 15 per cent consumption on either side of the L.M.P. setting, which is the range of stable operation, the main effect of mixture ratio seems to be during the initial stage of the cycle. The effect upon pressure is seen from the replotted indicator cards; the lower rate of pressure rise of the lean mixture is accounted for by the increased "pressure lag" due to the slow reaction at the start.

2—SPARK ADVANCE. The state of turbulence of the mixture at the instant of ignition depends upon the piston velocity at ignition. With increasing spark advance the piston velocity and turbulence at ignition increase, and this is responsible, to some extent, for the increase in the initial reaction velocities with increasing advance. While the effect of spark advance is the greatest at start, there is some evidence of increasing flame speed with increasing advance throughout the whole cycle. In Fig. 21 are shown flame diagrams and p-t records taken at 1500 r.p.m., full load, ignition at 5 deg. ATC, 5 deg. BTC, and 19 deg. BTC, respectively.

It is of interest to note the effect of the direction of the piston movement upon the initial flame. When the piston travels downward, *i. e.*, away from the ignition point, the initial inflamed portion is shifted toward the piston (see flame location at 15 deg. after ignition, upper left); when it travels upwards, toward the ignition point, the initial inflamed portion is shifted away from the piston (see flame location at 10

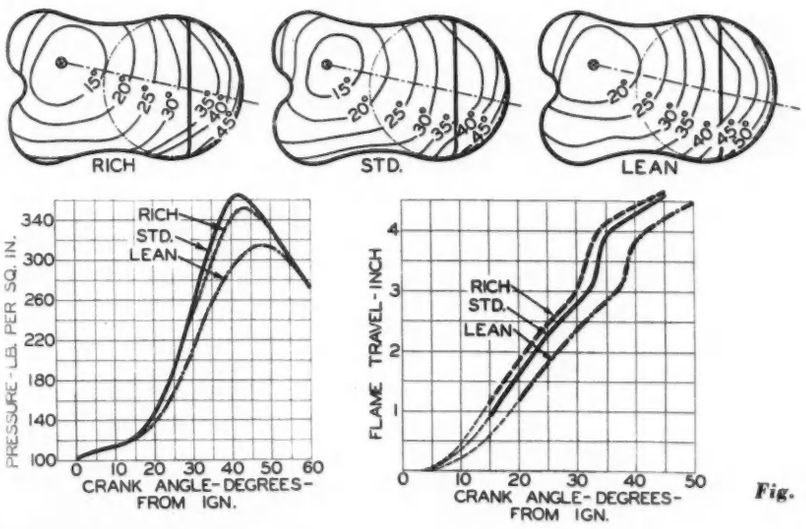


Fig. 20—Effect of mixture ratio on pressure and flame propagation.

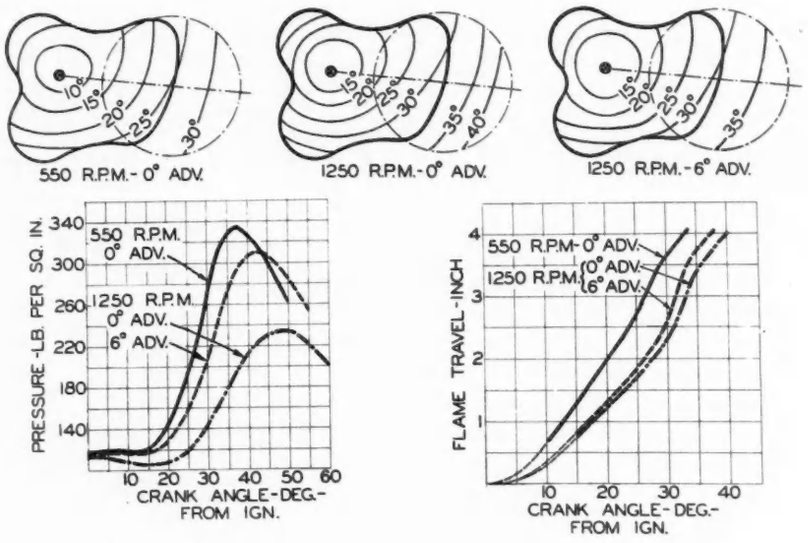


Fig. 22—Effect of engine speed on pressure and flame propagation.

deg. after ignition, upper right). In both cases the mass movement of the gases, induced by the piston motion, shifts the initial flame along with it. Due to this shift, an evaluation of the flame travel on the maximum travel line, using the ignition point as start, may give an erroneous picture. Therefore, to show on a comparative basis the initial flame speeds as representative of the reaction velocity, the mean flame speeds were plotted (bottom right) for the three spark advances. The values of the mean flame velocities were computed by averaging the distance between two consecutive flame fronts and dividing this value by the corresponding time in degrees. It is evident that an increase in the spark advance increases the initial rate of flame propagation.

3—ENGINE SPEED. (Turbulence level of mixture.) The turbulence level of the mixture is a function of engine speed and is the combined effect of intake turbulence and compression turbulence. It is the most important among the factors affecting reaction velocity. While the effect of engine speed upon reaction velocity depends upon constructional variables, in most cases an increase in speed does not result in a proportional increase in reaction velocity; this is the main reason for the necessity of increasing the ignition advance with increasing engine speed. The typical flame diagrams (top) and p-t records (bottom left) shown in Fig. 22 were obtained at 550 and 1250 r.p.m., at 0 deg. advance and at 1250 r.p.m., at 6 deg. advance. At 0 deg. advance, the pressures at 1250 r.p.m. are much lower than at 550 r.p.m., due to the fact that by increasing the speed from 550 to 1250 the reaction velocity did not increase in proportion; combustion lasts too long, and the effect of the piston movement causes the pressure to drop. By advancing to 6 deg. we increase the reaction velocity and at the same time decrease the effect of the piston motion upon pressure; the result is that the p-t curve becomes normal. The flame travel curve (botton right) shows that the effect of engine speed in increasing the flame speed is greater at the start than later during the cycle.

4—THROTTLE OPENING. Mixture conditions at part load seem to affect the flame propagation mainly at start. The flame records and p-t cards shown in Fig. 23 were obtained at 1500 r.p.m. full, 22 deg. and 28 deg. throttle position and a constant advance of 11 deg. BTC. The duration of combustion increases with decreasing throttle opening (see flame records and p-t cards), which explains the necessity for increasing the ignition advance at part load. The flame-displacement curves (bottom right) show that most of the difference in flame speed occurs in the first inch of travel; from that point on the flame velocities at full and part load are very closely the same.

5—TEMPERATURE OF UNBURNED MIXTURE. The effect of temperature of the unburned mixture was determined directly from flame records. Assuming that at the end of the chamber all the expansion of the burning increment is into the burned gas, the linear travel of the flame is due only to the burning and the rate of flame travel is, therefore, equivalent to the reaction velocity. A large number of flame records and p-t cards were obtained under various operating conditions and with several types of combustion chambers. In each case the chambers were fitted with enough ionization gaps at the end of the chamber opposite to

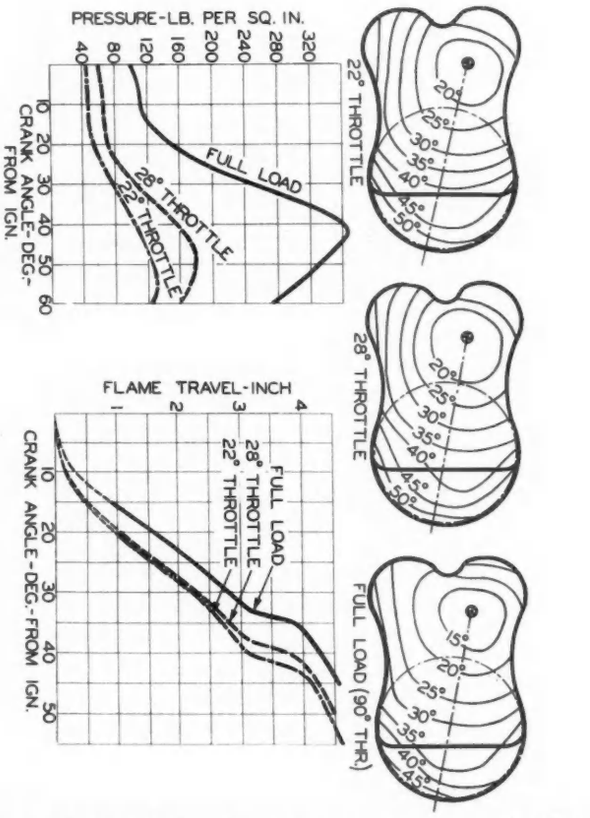


Fig. 23—Effect of throttle opening on pressure and flame propagation.

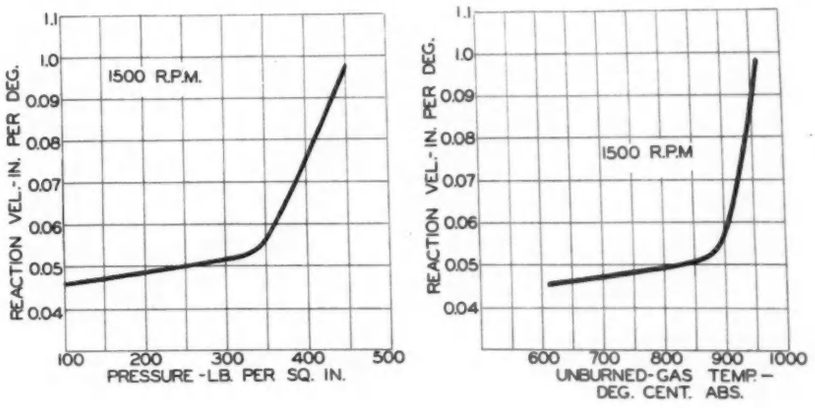


Fig. 24—Effect of pressure and temperature of unburned mixture on reaction velocity.

the ignition point, where the combustion ends, to record accurately the flame speed. By correlating, in each case, the reaction velocity (which in this case is identical with the mean flame velocity) with the pressure, and then substituting the unburned mixture temperature for the pressure, the relation between reaction velocity and unburned mixture temperature was established. Fig. 24 shows this relation for 1500 r.p.m. and Red Crown gasoline, using a maximum-power mixture. According to this curve, the effect of the unburned-mixture temperature on the reaction velocity is very small up to a pressure of 300 lb. per sq. in.; above this value the reaction velocity increases very fast with increase in temperature. The work of Mallard and LeChatelier (18) has resulted in establishing relations between reaction velocity and temperature which give curves similar to the ones shown in Fig. 24.

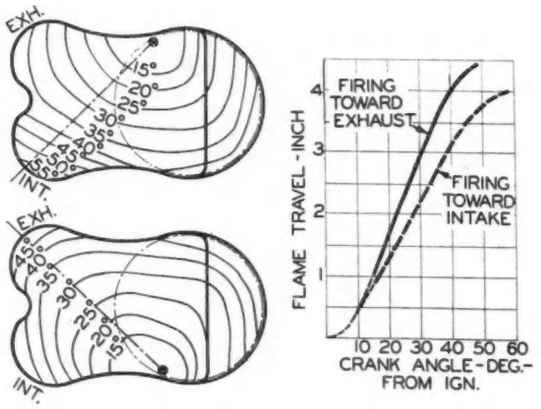


Fig. 25—Flame records showing that the flame travels faster toward the exhaust valve than toward the intake valve.

6—Local Heating. The effect of hot surfaces in the combustion chamber in speeding up the reaction is shown in Fig. 25. The temperature distribution in the side wall and roof surface of a typical chamber is shown in Fig. 26; the whole side wall on the exhaust side is much hotter than the rest of the chamber. This relative difference between the intake and exhaust sides is not affected materially by the ignition point, spark advance, load, and coolant temperature. The flame records in Fig. 25 were obtained at 1500 r.p.m., part load, and 22 deg. advance. The initial mixture conditions and flame speeds in both records are identical. But as soon as the flame enters the valve zones, it travels faster on the exhaust side than on the intake side, as shown in the flame-travel vs. crank-angle plots.

7—Local Turbulence. Experimental evidence indicates that whenever the flame front reaches a sudden change in the chamber contour, there is an increase in reaction velocity, which is shown both by an increase in rate of pressure rise and by an increase in flame speed. The combustion chambers used in most of the present day L-head engines are of the so-called "offset" design, incorporating a more or less vertical "end wall" above the piston, thus dividing the combustion chamber into two parts, the first, the main chamber, consisting of the cavity in the cylinder head and the gasket space under it, the second, the "close-clearance space," consisting of the narrow space between the bottom of the head and the piston. The effect of the turbulence, caused by the sudden drop in height, is shown in Fig. 27. Chamber *D* has no "end wall" over the piston, whereas Chamber *E* has. The

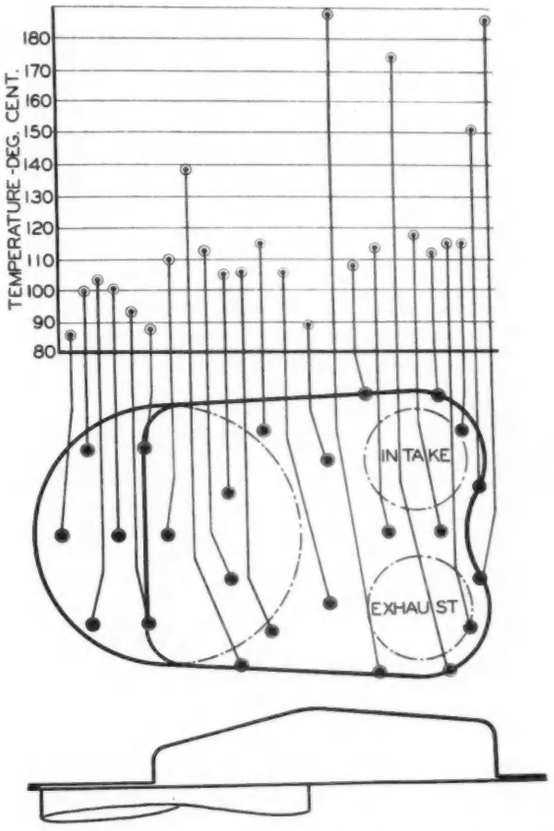


Fig. 26—Wall-temperature distribution in a conventional L-head combustion chamber.

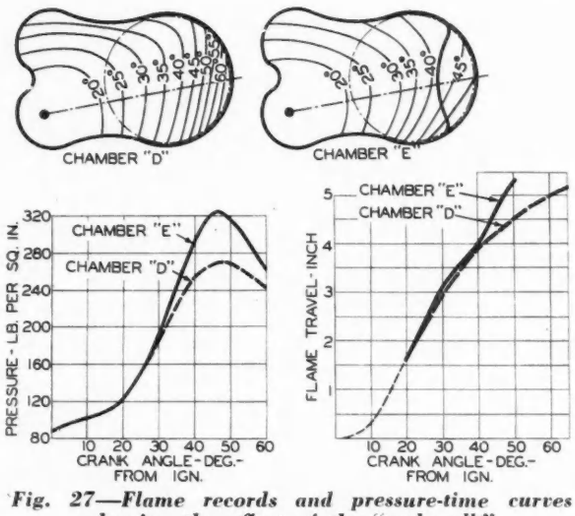

CHAMBER "D"
CHAMBER "E"
CHAMBER "E"
CHAMBER "D"
PRESSURE - LB. PER SQ. IN.
CRANK ANGLE - DEG. - FROM IGN.
FLAME TRAVEL - INCH
CRANK ANGLE - DEG. - FROM IGN.

Fig. 27—Flame records and pressure-time curves showing the effect of the "end wall."

increase in flame speed and in the rate of pressure rise in Chamber *E* is clearly seen. From the start until 4 in. of travel on the maximum-travel line (approximate location of the end wall in Chamber *E*) the flame speed in both chambers is very closely the same (see flame-travel curves, bottom right). The rate of pressure rise from the 30-deg. line to the 40-deg. line is somewhat higher in Chamber *E*, because for the same flame position the burned volume is more, since Chamber *E* is higher than Chamber *D*. Beyond the 4-in. point the flame in *D* slows down, while in *E* it accelerates. This effect, however, could not be found in cases where the "end wall" cuts the flame front at a large angle. In Fig. 28, left, flame diagrams and flame travel curves are shown for two firing positions in the same chamber. Firing from position 1, the end wall is substantially parallel with the flame front, causing an increase in flame speed; firing from position 2, the "end wall" is nearly at right angles to the flame, causing no change whatsoever in the flame velocity. In the same figure at the right, the effect of the bottom of the "end wall" is shown. Judging by the pressure-time curves, the turbulence effect on the reaction velocity can be reduced by joining the "end wall" with the bottom of the head by means of a radius, thus eliminating the sharp corner. The pressure rise in this region is steeper in the case of a sharp corner than with a ¼-in. radius.

8—FLAME TURBULENCE. The reaction-velocity curve presented in Fig. 17 is typical of a flat chamber having no clearance space (end-wall effect) or other sudden changes in contour. Under such conditions the important factors present affecting the reaction velocity would be the local heating effect of the exhaust valve, and the temperature of the unburned mixture, which would presumably increase the reaction velocity toward the end, if the pressure exceeds approximately 300 lb. per sq. in. Instead, we see a very decided "hump" in the reaction-velocity curve right at the initial stage. From all the experimental evidence at hand, it seems that the element responsible for this variation is the mass movement of the gases caused by the expansion of the burning zone toward the unburned mixture. Its velocity being well within a range to cause turbulence, it has an accelerating effect upon the initially low reaction. To differentiate between this effect and the local turbulence effect of contour changes, we refer to it as "flame turbulence." In chambers having a clearance space, the accelerating effect of the end wall is superimposed upon the effect of the flame turbulence. In the chamber shown in Fig. 29, upper left, the reaction velocity shows a second hump at *A*, caused by the end wall; without the end wall the curve would run as shown at *B*. If the end wall is closer to the ignition point, as in the two chambers, upper right and lower left in the same Fig. 29, the second hump blends into the first one. The curve at lower right shows the range in reaction-velocity values for chambers with clearance space, for 1500 r.p.m., full load, and a maximum-power mixture.

Some of the results presented in the preceding sections, showing the effect of variables upon the flame velocity, are substantiated by several authors (19, 20, 6).

Combustion Time, Power, Detonation

The ultimate object of engine combustion control is to achieve, for a given fuel rate, the highest possible output without detonation and without excessive roughness. The most important element in combustion control is *time*. The peak pressure, which is generally indicative of power output, depends, for a given mixture weight and initial conditions at ignition, upon the volume of the chamber (continuously changing due to piston movement) and consequently, upon the duration of the combustion. Normally, the shorter the time necessary to complete the reaction, the less the volume

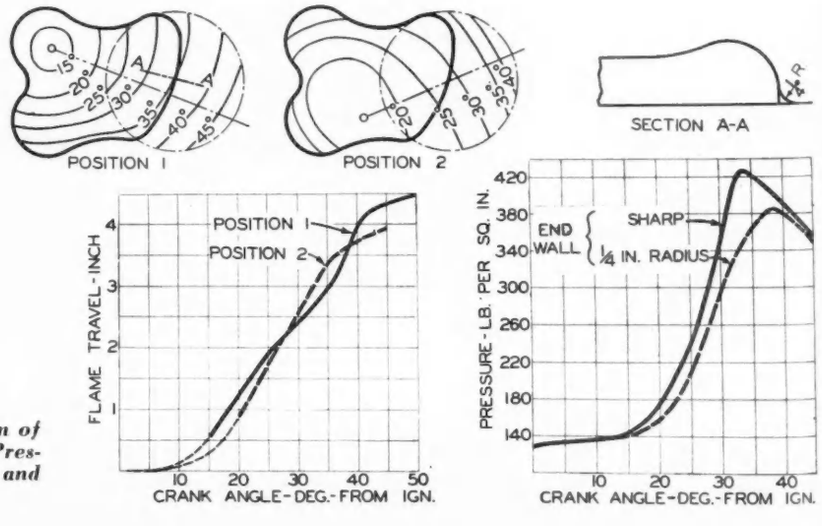


Fig. 28—(Left) "End wall effect" is a function of the angle between flame and wall. (Right) Pressure curves showing effect of sharp corner and ¼ in. radius at the base of the end wall.

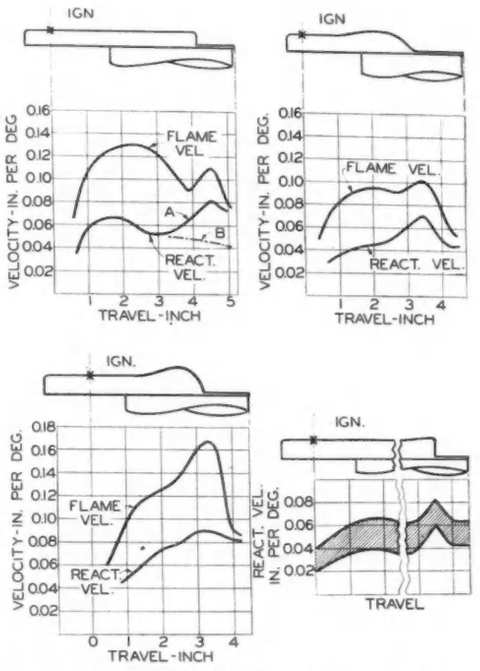


Fig. 29—Effect of chamber contour on flame velocity and reaction velocity.

increase of the chamber, and, hence, the higher the peak pressure.

Detonation, according to recent theories (21), depends mainly upon the time during which the last portion of the unburned mixture is subjected to certain physico-chemical processes. Hence, the quicker the flame reaches this critical portion, the greater is the probability that the same will burn normally.

Roughness can be successfully controlled by the volume distribution in the chamber. This determines primarily the variation in the rate of pressure rise during combustion, but has no direct bearing upon the total combustion time.

The combined effect of combustion time upon power and detonation is best represented by the value of the peak pressure for borderline detonation. In Fig. 30 four different combustion chambers are shown, with p-t and flame records taken at 1500 r.p.m. and full load, the ignition advance in each case being that for borderline detonation. Chamber *D* has the highest useful peak pressure of 435 lb. per sq. in. The flame record shows very high flame speed, an evidence of a high degree of compression-turbulence and flame-turbulence. The total combustion time is 44 deg. Head *C* has a somewhat lower peak pressure of 380 lb. per sq. in. and a longer combustion time of 47 deg. The initial flame speeds are approximately the same in Chambers *D* and *C*, but the volume enclosed by the 20-deg. line is much larger in Chamber *D* (higher chamber), and consequently the pressure rises at a higher rate than in *C*. Also, it is reasonable to expect that compression turbulence in Chamber *D* is higher (sloping roof), causing a higher flame speed and higher rate of pressure rise in the main section of the chamber from the 20-deg. line to the "end wall." The "end wall" effect, however, is more pronounced in Chamber *C* (bigger drop), but the increased flame speed in the "clearance space" caused by this effect is not sufficient to offset the low flame speed between the 20-deg. line and the end wall, so that the total combustion time is longer in *C* than in *D*.

Chamber *B* is evidently less turbulent than *C*; the flame is especially slow at start. The combustion time is 51 deg. and the peak pressure 340 lb. per sq. in. The flame speed in Chamber *A*, although fairly high at start, becomes very low from the 30-deg. line on. This is due to the absence of an "end wall." The combustion time in Chamber *A* is 57 deg., and the peak pressure only 260 lb. per sq. in.

The relationship between combustion time and the highest "useful" peak pressure evidenced in these four chambers, was found to hold true with reasonable accuracy in a great variety of designs, and under various operating conditions. No other factor (spark advance, design characteristics, pressure rates, etc.) showed any such relationship. Further evidence of the fundamental importance of the time element in detonation is presented in Fig. 31, which is based upon results of 63 tests with nine different L-type chambers, at full load, compression ratio 6:1, speeds from 500 to 2800 r.p.m., and maximum-power mixtures of Standard Oil Red Crown gasoline. In each case pressure-time and flame records were obtained at borderline detonation, and from these the pressures at which detonation started (critical pressures) and the corresponding times from ignition (critical times) were evaluated. Theoretically it would be more accurate to compute the times from a given unburned-mixture temperature, rather than from ignition, as, presumably,

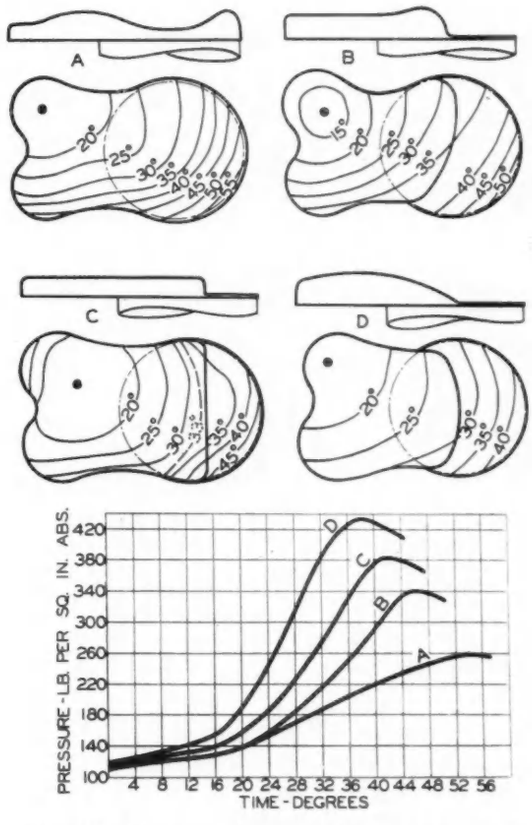


Fig. 30—Pressure-time and flame-propagation characteristics of four typical chamber designs.

for every fuel there is a minimum temperature at which the mixture will detonate if held long enough at that value. From the regularity of the curves one is forced to assume that this temperature is within the range of normal ignition advance, at the operating conditions stated above. The fact which may be deduced from these curves is that, for knock-free operation, at any given time from ignition in the combustion cycle, the pressure in the chamber must be below the "critical pressure" corresponding to that time. For a given critical pressure, if the speed is increased, the critical time, in seconds, decreases; *e. g.*, for a pressure of 380 lb. per sq. in. at 1200 r.p.m., the time is 36 deg. or 5 milli-seconds; for the same pressure at 2400 r.p.m., the time has to be decreased to 45 deg. or 3 milli-seconds. Apparently the increased turbulence at the higher speed increases also the speed of the preflame reaction in the critical portion of the mixture.

The dotted line in Fig. 31 represents the characteristics of a present-day engine of standard design. Taking the high-speed part of the curve at par, it is evident that at low speed it is below the optimum in that the pressures obtained are lower than expected. At 2800 r.p.m. the peak pressure is 390 lb. per sq. in. at 46 deg. from ignition. Assuming that the volumetric efficiency remains the same at 1400 r.p.m., we should be able to obtain at least the same pressure; to do so, however, the combustion time should be 38 deg. Actually this time is approximately 41 deg., which limits the pressure to the critical value of 360

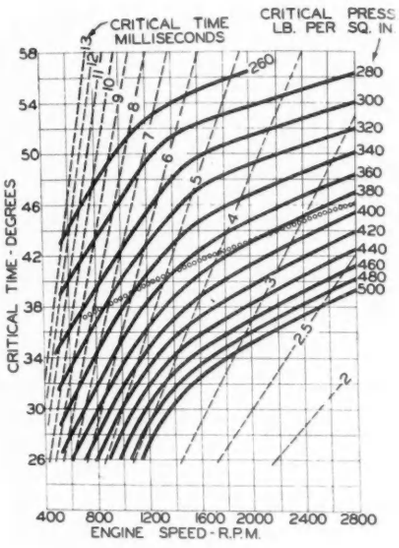


Fig. 31—Relation of critical pressure (for incipient detonation), critical time, and engine speed.

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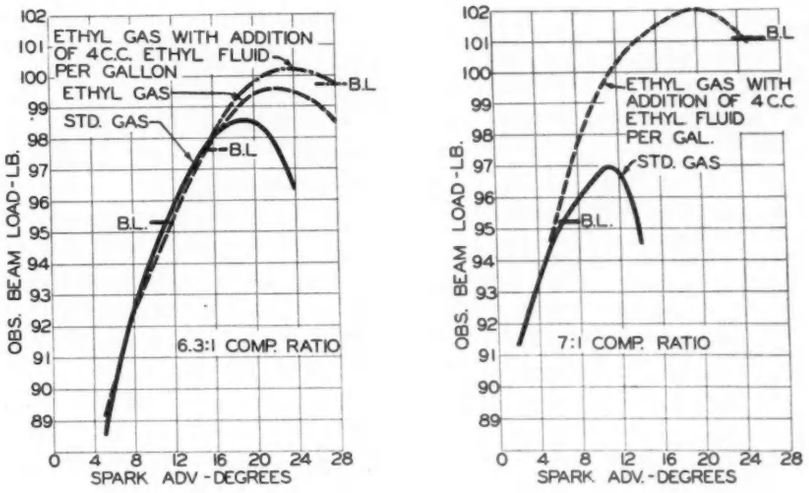


Fig. 32—Spark "fish-hooks," showing loss of power due to detonation.

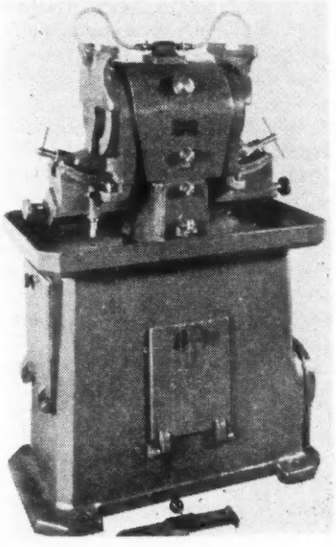
lb. per sq. in. The difference 390-360 represents the loss due to spark retard for borderline detonation. The obvious remedy is to speed up the reaction in the lower speed range. Of the tools at the disposal of the designer, turbulence and mixture control are the most effective. Turbulence is mainly a matter of chamber contour and volume distribution. The contour of the chamber and piston affects the turbulence of the mixture, first, during the compression (compression turbulence), hence, it is important in determining the initial rate of reaction; and, second, during combustion (local and flame turbulence). Mixture control is of greatest importance in providing a fast-burning mixture at the ignition point, as the initial state of the combustion seems to be the most sensitive to variations in mixture. For that matter, turbulence (engine speed, spark advance) also has a greater effect upon the initial stage than upon the later phase of the combustion process. In order to decrease the total time necessary to complete the reaction, it would seem most promising to speed up the initial stage.

Means will have to be found to increase turbulence in general, but especially around the spark plug. At the same time a more rational control of the mixture conditions has to be devised to insure a good inflammable and fast-burning mixture at the start—otherwise a spark is necessary which is able to cope successfully with the vagaries of the mixture at the spark-plug gap.

The loss in power due to detonation is shown in Fig. 32. This shows spark fish-hooks of an 8-cylinder engine operated at 6.3:1 (left) and 7:1 (right) compression ratio, at full load, 1500 r.p.m. While these self-explanatory curves do not show anything new, they do indicate the order of magnitude of the gain in power which can be realized by reducing or eliminating detonation. Undoubtedly, much has been achieved by means of combustion-chamber design and fuel research; it is felt, however, that the most important factor, the time element, so far has not received proper consideration. Future efforts should be extended in that direction.

Template Tool Bit Grinder

The Oliver Instrument Co., Adrian, Mich., is now manufacturing a tool bit grinder which produces automatically any desired shape on a regulation tool bit up to ¾ in. square. Essential elements of the machine include a holder for the tool to be ground, which holder rests on a ball and socket joint at its lower end and has at its upper end a template giving the exact shape of the tool form, twice size. This tool holder is placed on a ball which forms a part of the wheel guard, and the template is held so that it may contact a straight edge, also a part of the wheel guard. The tool is rocked against the wheel until the template comes in contact with the straight edge and no more metal can be ground from the tool. The machine is equipped with a roughing and polishing wheel.



Oliver template tool bit grinder.

In this machine the necessity for providing a template has been obviated by a special holder in which a tool of the exact shape desired may be inserted and a blank template attached in its proper place. The tool is then rocked against a steel form and the template is ground to exact shape on the wheel. The template is then placed in the regular tool holder and will reproduce the tool shape. Setting gages are provided on the machine which regulate the amount of metal which it is desired to remove from the tool.

Any desired degree of clearance may be obtained by tipping the wheel guard in the proper relation to the wheel. Adjustment is provided for this and the clearance indicated on a graduated scale. The exact relation of the wheel to the straight edge and ball socket is maintained by means of a diamond holder which fits on the wheel guard in the same way that the tool holder is held.

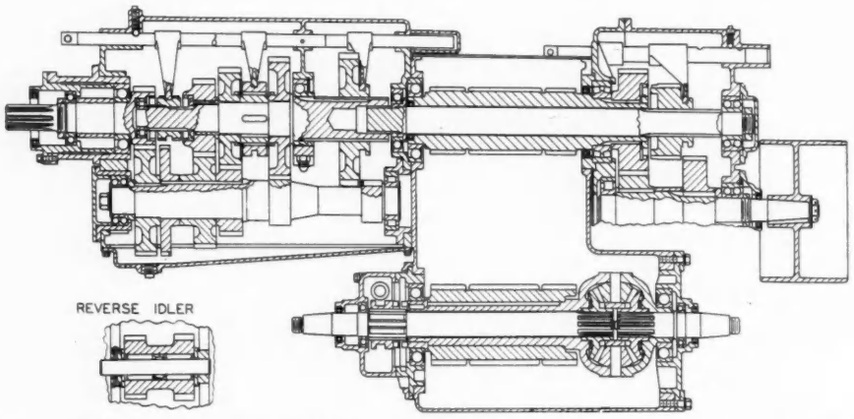
Transmission Designed For Heavy Duty Service

A NEW five-speed transmission for heavy-duty four- and six-wheel-drive trucks, recently announced by the Four Wheel Drive Auto Company, is so designed that an auxiliary two-speed transmission can be combined with it, the combination providing ten forward speeds and two reverse.

With the exception of first-speed and reverse, all of the gears are of the helical constant-mesh type. Sliding clutches are used throughout. A transfer case bolted directly to the transmission case contains a silent chain 12 in. wide, which transfers the power from the level of the transmission main shaft to a level 17-7/16 in. lower, where a four-pinion differential divides it between the front and rear axles. A locking arrangement, controllable from the driver's cab, is provided and permits of obtaining a solid drive to both axles under conditions making this desirable. With the transfer case bolted directly to the transmission, the usual alignment joints and short connecting shafts of four-wheel drives are eliminated. The silent chain, moreover, is said to act as a cushioning medium protecting the driving mechanism from shock. Eccentrics on the bearing supports of the lower chain sprocket permit of adjusting the chain for wear.

The new transmission and transfer case and its optional two-speed auxiliary form a single unit which has a three-point mounting at the center of the truck frame. The front end of the transmission is supported by a cast-steel cross member with a trunnion mounting, while the transfer case has integral supports that are bolted directly to the truck frame.

Provision for a power take-off is made on each side of the transmission case. The two-speed auxiliary transmission is so arranged that its low-gear ratio may be given a value ranging between 1.75 and 2.50. With the proper selection of the low-gear ratio in the auxiliary, the truck will operate at from 15 to 18 m.p.h. in high gear low range, thus avoiding the use of the gears in the regular transmission in such work as snow removal. Splines and jaw clutches of the new transmission are of the involute type. The transmission case is well ribbed, to provide cooling and reduce noise, and it is said to have enough oil capacity for continuous low-gear operation. A parking brake is always provided. When the auxiliary transmission is not fitted, this brake acts on the main shaft of the upper chain sprocket, while with the auxiliary transmission it acts on the countershaft of the latter.

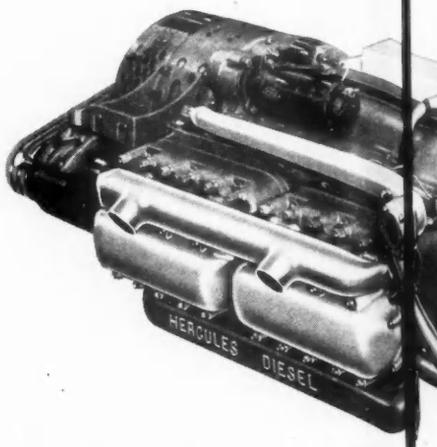


Longitudinal section of FWD five-speed transmission with transfer gear and two-speed auxiliary gear

This truck transmission is available in the M series of FWD trucks which range in capacity from 6 to 25 tons and which come with either four-wheel or six-wheel drive and with either diesel or gasoline powerplants.

Diesel Line Hercules

HERCULES MOTORS CORP. has recently added a number of new types to its line of Diesel engines. Of particular interest among these is the DFX Series, a horizontal six-cylinder engine designed primarily for bus and railcar installations, with the overall height reduced to the minimum. In designing the engine, special care was taken to ensure proper lubrication. An oil tank is built directly into the oil pan, and the oil capacity is nearly 10 gals. A scavenging pump keeps the sump dry and delivers all of the oil into the tank, from which the pressure pump draws its supply through a screen of large area. The oil is delivered through a Nugent-type lubricating-oil filter into the main header, from which the different bearings are supplied.



Series DFX six-cylinder horizontal engi

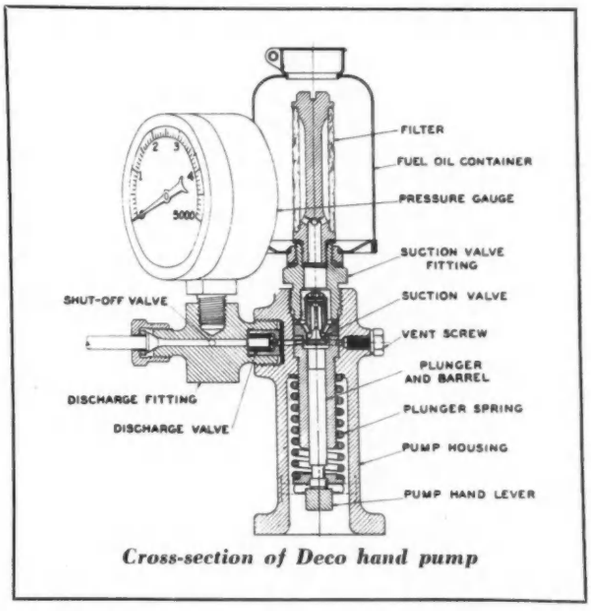
Built integral with the fuel pump is a suitable governor, the combination being either driven from the front end of the camshaft or mounted on top of the engine block and driven through a chain.

Series DFX engines will be built in three sizes, with 5 by 6-in., 5¼ by 6-in. and 5½ by 6-in. cylinder dimensions.

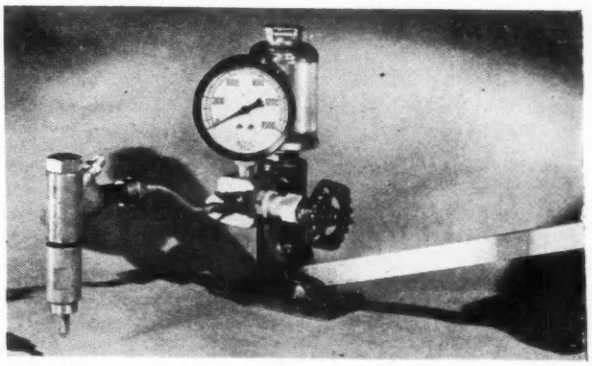
A new two-cylinder Hercules Diesel, Series DIX, also incorporates some interesting features. It has the same bore and stroke and the same combustion system as the well-known Hercules DOO and DJX engines, and

Deco Hand Pump Tests Injectors on the Engine

A HAND pump for testing fuel injectors and other hydraulic devices has been placed on the market by Diesel Equipment Corporation, Chicago, Ill. It consists of a pump unit having the same barrel, plunger, suction valve, and delivery valve as the Deco fuel-injection pump, and is operated by means of a detachable handle. The sectional view reproduced herewith shows the design. It can be used to test injectors of different makes and sizes. Injectors can be tested on the engine, and only when the test shows that adjustment is required is it necessary to remove them. The injector opening pressure is shown by a gage screwed into the discharge fitting of the hand pump. Precision gages with three different scale ranges are available, viz., 1500, 2500, and 5000 lb. per sq. in. A shut-off valve is provided in the fuel supply line, so the pump can be used without subjecting the gage to the fuel pressure when pressure readings are unnecessary, which adds to the life of the gage. In addition to giving the injector opening pressure, the unit can be used to determine whether the spray pattern is uniform, and to detect stuck needle valves and dribble or leakage around the valve seats.



Cross-section of Deco hand pump



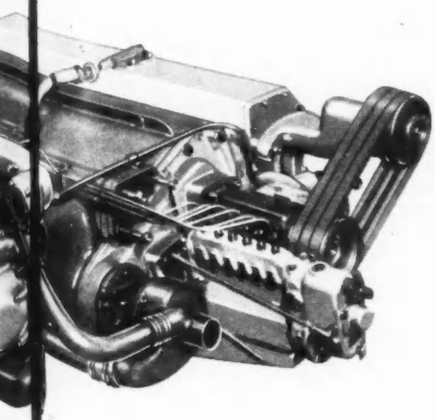
Deco hand pump for testing fuel injectors

The hand pump is designed to be used in the field by engine-dealers' service men, fleet operators and laboratory engineers. It is 9 in. high and weighs 6 lb. without the handle, which weighs 2 lb. Because of its compactness it can be readily stowed in service kits and truck or tractor tool boxes.

Expanded by Additions

most of its vital parts are interchangeable with the corresponding parts of these engines. A large flywheel and a decompression device built into the cylinder head facilitate hand cranking. Torch holders which provide for the insertion of glowing paper torches into the combustion chamber facilitate starting at low temperatures.

The fuel pump and governor are incorporated in the design of the cylinder block itself. Easily-replaceable fuel plungers are actuated by the engine camshaft. An entirely-enclosed but easily-accessible flyball-type governor is mounted on the camshaft gear. Engine speed can be controlled within a wide range by means of an outside control lever. A large-capacity gear-type oil pump is located at the forward end of the engine, and is driven directly from the gear on the crankshaft. It draws oil through a liberally-dimensioned screen from the oil sump and delivers it to the crankshaft bearings. A by-pass line conducts a portion of the oil through a replaceable-unit-type of filter to the rocker arms on top of the cylinder head. From the valve housing the oil is drained to the valve and fuel-pump tappet compartment, whence it drains through the timing-gear housing to the oil sump. The counterweight on the crankshaft is located outside the crankcase.



engi...cent addition to the Hercules Diesel line

Labor and The Law

(*Continued from page* 612)

measured. * * * Instead of imposing upon employers, and employes, wages, hours, rates or production and grievance procedure established by government fiat, it looks to the *freely chosen* representatives of employers and employes to thrash out their own difficulties and make their own bargain at the council table. * * * As the Supreme Court of the United States has held, *freedom of choice* in the selection of representatives must be safeguarded if any such a voluntary plan is to accomplish its purpose."

The essence of American democracy lies in those words *freely chosen* and *freedom of choice.* (The italics are ours.) The essence of Stalinism lies in the methods used to drive automotive workers into organization.

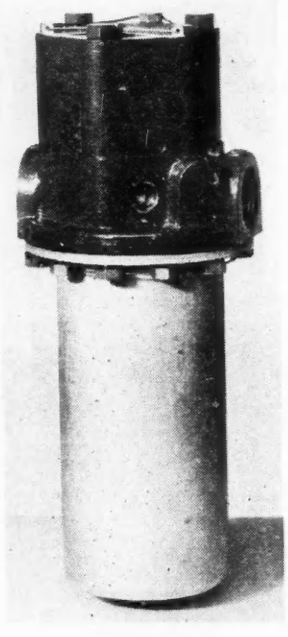
Repetition of a truth may rub off some of its brilliance but cannot wear it out. It it just as true today that privilege begets responsibility as it was when that fact was first stated. Added privileges and resupported rights bring with them added duties as natural consequences. The extra legal protection of the right of workers to organize and bargain over wages and working conditions collectively, provided by the Wagner Act, imposes on workers and particularly on labor leaders an emphasized obligation to refrain from all forms of illegal activity in the exercise of that right. If labor leaders do not see to it that lawful courses are followed, then government must. If labor leaders will not or cannot prevent unnecessary stoppages of production or distribution, slowdowns, harmful interference with interstate commerce, and coercion of individual workers, the law must take a hand. If the hand of the law is not strong enough, it must be strengthened, and still more new tools must be forged for a "new role of government in democracy." So reads the writing on the wall.

Completely Automatic Self-Cleaning Filter

In the field of lubricating and hydraulic oil filtration as applied to machine tools one of the latest developments is a completely automatic self-cleaning filter built by the Cuno Engineering Corp., Meriden, Conn.

On the company's earlier models of this equipment, cleaning is accomplished by turning an external handle at periodic intervals. By this action the filter cartridge is thus rotated past stationary cleaner blades which extend into the slots between disks and reject all accumulated solids.

On the new automatic model, the cartridge is turned continuously by an oil driven motor contained in the filter head. Driving force for the motor is obtained from the differential pressure between the discharge and suction side of the oil pump. The reciprocating motion of a piston operating in a cylinder is converted to rotary motion turning the cartridge continuously. A toggle device for valving the oil to the piston reverses the oil flow to the piston thereby eliminating the possibility of a dead center position of the piston and valve.



The completely automatic self-cleaning filter, designed for external mounting, which is a development of the Cuno Engineering Corp.

Men and Machines

(*Continued from page* 628)

Several new mechanisms added to the Brown & Sharpe Mfg. Co.'s line of *attachments for automatic screw machines* are described in recently issued circulars. The mechanisms are: A longitudinal turning attachment for use on B&S Nos. 00 and 00G automatic screw, turret forming, cutting-off and screw threading machines (high speed); Motor drives for cross drilling attachments for use on B&S Nos. 00G, 0G and 2G automatic screw machines (high speed); Motor drives for turret drilling attachments for use on B&S Nos. 00G, 0G and 2G automatic screw and turret forming machines (high speed); Motor drives for cross drilling and turret drilling attachments for use on B&S Nos. 00G, 0G and 2G automatic screw machines (high speed).*

National Broach & Machine Co., Detroit, has issued a pamphlet on *"Roto Shaving,"* a method of finishing circular, cylindrical and conical surfaces, especially those which are to become locating surfaces for subsequent machining operations.*

The National Acme Co., Cleveland, has prepared a handbook for operators of its *Acme-Gridley multiple spindle bar machines.* It is offered free to Acme-Gridley operators only.

*Obtainable from editorial department, AUTOMOTIVE INDUSTRIES. Address Chestnut and 56th Sts., Philadelphia.

NEWS OF THE INDUSTRY

Producer Gas in the Limelight, See page 645.

Detroit's Place In a Future War

Dow Explains Plan For Work Division

A "coffee talk" by Alex Dow, president, Detroit Edison Co., at the Dec. 4 meeting of Detroit section S.A.E. dealt with a brief perspective of the ordnance work proposed in the Detroit area, should a national emergency arise. Profiting by the experience of the last war, the military establishment has created 14 ordnance districts in the U. S., each one controlled by a civilian executive. The latter, in turn, will have two assistants, one of them an army officer. Civilian chief for the Michigan area is Mr. Dow.

In line with the current policy, all production facilities in the Michigan area have been carefully surveyed and earmarked for specific activity—aircraft, quartermaster, ordnance, etc. Some establishments will specialize, others may handle assignments for several types of activity. However, in

(*Turn to page* 648, *please*)

Germany Limits Light Metal Use

Germany, according to information received at the Commerce Department, has taken steps to prohibit the consumption of light metals and their alloys for all but specifically mentioned purposes. A distinct departure from those hitherto in effect, in that they do not stipulate specific uses for which the metals are forbidden, the new restrictions limit the metals for all but specific uses. Previously, the report said, there were practically no restrictions on the consumption of light metals, particularly aluminum and magnesium, because of adequate supplies in Germany.

The report said that in the future light metals may be consumed without specific permit, only for (1) products regularly manufactured by individual firms, (2) materials for military use, (3) products for export, and (4) special exceptional purposes specifically approved by the trade control authorities. Government officials in this country regard the restrictions as indicative of a growing tension in supply and demand for light metals in Germany.

International

To Share Economy

Roy A. Hunt, president of Aluminum Co. of America, who has announced that "there will be no advance in Aluminum Co. of America domestic prices for aluminum ingot during the first quarter of 1940." Stating that the company is not in favor of taking advantage of extraordinary conditions, such as those created by the present war situation, to seek prices out of harmony with costs, Mr. Hunt added, "Benefits of research and development, together with expansion of plants and facilities, permit the company to expect lower costs and, in line with its expressed policy, it intends to share such economies with the consumers of aluminum."

Chrysler Reports Nine-Month Profit

Net profit of Chrysler Corp. for the nine months ended Sept. 30, 1939, was $31,403,118.39, as reported by the company. This compares with $6,671,877.81 for the comparable period of 1938.

Sales for the period totaled $441,-895,379.54, as compared with $236,732,-939.85 for the same period of last year. Sales included 631,355 passenger cars and trucks as compared with 318,137 in 1938.

Directors of Chrysler Corp. at their meeting on Dec. 1 declared a dividend of $1.00 per share on the common stock of the corporation, payable Dec. 23, 1939, to stockholders of record Dec. 9.

Seek to End Trade Barriers

Hopkins Proposes Committee To Study Interstate Bars

An interdepartmental committee whose job would be to cooperate with trade associations, professional groups and other business organizations and to coordinate government activities in seeking the elimination of interstate trade barriers, has been proposed by Secretary of Commerce Harry L. Hopkins in letters directed to the Departments of State, Agriculture, Labor and Justice, to the National Resources Committee and to the new Federal Works Agency.

While most observers were dubious over the outcome of the committee's activities, the move was regarded as at least a governmental gesture of some value to those groups in business and industry which have suffered business losses because of the barriers between states.

Through Paul T. Truitt, of the Com-

(*Turn to page* 647, *please*)

Martin Aircraft Declares Dividend

At a meeting of the board of directors of The Glenn L. Martin Co., a dividend of $1.00 per share was declared, payable Dec. 21 to stock of record as of Dec. 11, 1939. There are approximately 1,092,308 shares outstanding.

Deliveries for the first eleven months of 1939 approximated $20,110,823, Mr. Martin, president declared with total deliveries of more than $24,500,000 indicated for the year.

James R. Way

James R. Way, originator of the cast aluminum body, which was a feature of the Pierce-Arrow automobile, died, recently, at his home in Buffalo, N. Y., at the age of 79.

Born in North Carolina, he went to Buffalo about 49 years ago. After working for carriage firms for several years, he joined the Pierce-Arrow Motor Company in 1903. He became chief body designer and was in charge of body building operations for the company for more than 25 years.

Steel Output at Top Tonnage Maintains Even Flow to Plants

Nonferrous Metal Markets Jolted by $10 per Ton Cut by Zinc Marketer

Although the flow of steel to automobile manufacturers' plants and to those of parts-makers is thought to represent a greater tonnage than at any time this year, the movement could hardly be more orderly. Punctual arrival of shipment after shipment of body and fender stock explains largely why the slightest delay in receipt of this or that lot of special steels comes in for adverse comment. Assured that there will be no change in the market's price structure as a whole for the new year's first quarter, buyers, who anticipated their needs to be protected against price advances, now are only too glad if shipment of material is somewhat delayed. Some also want to defer taking in steel, that is not immediately needed, until inventories are out of the way. Lightening of pressure for early shipment makes it possible for steel producers to spread out orders on their books over a longer period and to recondition overworked equipment. Guided in their purchasing policies and shipping releases solely by their own assembly schedules, automobile manufacturers are expected to extend sufficient support to the steel market in the first quarter to more than make up for seasonal declines in demand from the construction and other steel-consuming industries. Hot rolled wire rods, formerly priced per gross ton, will be priced per 100 pounds for delivery beginning Jan. 1, 1940. Minor price advances on several gages were announced. The uninterrupted rise in steel mill operations, which began in September, came to a halt the week ending Dec. 9, when the American Iron & Steel Institute scheduled ingot output at 92.8 per cent of capacity, as compared with 94.4 per cent in the preceding week. A leading producer of merchant pig iron has reaffirmed prevailing prices for the first quarter of 1940.

Following an advance of one-fourth of a cent per pound in the price of brass products, one of the large marketers of zinc announced a $10 per ton price cut in that brass-making metal. This move gave all of the non-ferrous metal markets a jolt. In the outside market, holders of electrolytic copper, tired of waiting for a rise in the price quoted by producers, offered spot metal at 12.90 cents and futures correspondingly lower. Producers continued to name 12½ cents for spot electrolytic and to restrict sales to regular consumer-customers.

The International Tin Committee has fixed the export quota for the first quarter of 1940 at 100 per cent of standard tonnages. If the individual producers live up to this export allowance, the market should be in good supply. In expectation of this, prices eased off somewhat, spot Straits being obtainable on Tuesday, Dec. 4, at 52 cents. The tin market took much interest in a report that 500 tons of tin were re-exported from here to a Scandinavian country, from where it could be reshipped to the non-tin producing belligerents, in spite of the paucity of the metal's supply in the United States. —W. C. H.

Crude Rubber Consumption In Sept. Tops '38 by 25%

Consumption of crude rubber by manufacturers in the United States during the month of September, 1939 is estimated to be 50,150 long tons, which compares with 50,481 long tons during August, 1939. September consumption shows a decrease of less than 1 per cent under August and is 24.8 per cent over September a year ago according to the Rubber Manufacturers Association, Inc.

Happy Birthday

This is a birthday season for the Packard Motor Car Co.—the fortieth. The first Packard car was completed Nov. 6, 1899. A partnership, organized to build other Packard cars, was formed Dec. 30, 1899. The first sale of a Packard car occurred Jan. 3, 1900.

J. W. and W. D. Packard, electrical fixture manufacturers, built the first Packard in their factory at Warren, Ohio. It ran so successfully that the Packards formed a partnership with George L. Weiss, one of the organizers of the Winton Company, to build more of the machines.

In the fall of 1900 the first automobile show was held in the old Madison Square Garden in New York. Packard is the only now existing company which displayed its horseless carriages in this show. All of the three cars exhibited were sold. These sales and the certain promise of more launched the newly formed partnership into the Ohio Automobile Co., formed in 1900. The name was changed to the Packard Motor Car Co. in 1902, and the plant was moved to Detroit in 1903.

Ten Months' Record of Automotive Exports and Imports

	OCTOBER 1939		OCTOBER 1938		TEN MONTHS ENDED OCTOBER 1939		TEN MONTHS ENDED OCTOBER 1938	
	No.	Value	No.	Value	No.	Value	No.	Value
EXPORTS								
Automobiles, parts and accessories		$ 18,899,831		$ 17,303,333		$ 209,026,459		$ 215,811,085
PASSENGER CARS								
Passenger cars and chassis	9,318	5,842,470	10,822	6,712,801	115,562	70,910,575	120,349	75,323,970
Low price range $850 inclusive	8,108	4,582,401	9,364	5,190,477	103,018	57,686,655	105,058	58,761,067
Medium price range over $850 to $1,200	985	916,618	1,273	1,218,865	10,720	10,183,921	13,051	12,706,922
Over $1,200, not over $2,000	193	267,912	159	236,730	1,507	2,208,965	1,751	2,596,128
Over $2,000	32	75,539	26	66,729	317	831,034	489	1,239,853
COMMERCIAL VEHICLES								
Motor trucks, buses and chassis (total)	8,655	4,661,029	6,081	4,075,491	94,907	58,474,943	93,108	60,427,383
Under one ton	1,381	517,710	521	232,970	14,197	5,909,367	13,180	5,623,375
One and up to 1½ tons	6,072	2,894,680	4,315	2,276,946	66,128	35,893,633	63,462	35,303,497
Over 1½ up to 2½ tons	965	616,922	706	600,411	10,612	9,387,504	10,204	8,253,890
Over 2½ tons	203	589,667	503	929,203	3,357	6,718,121	5,107	10,131,630
Bus chassis	34	42,050	36	35,961	613	566,318	1,155	1,114,991
PARTS, ETC.								
Parts except engines and ties								
Automobile unit assemblies		3,822,440		2,163,862		33,672,245		37,080,389
Automobile parts for replacement (n.e.s.)		3,216,827		3,411,804		32,582,734		30,576,007
Other automobile accessories (n.e.s.)		458,644		443,085		3,481,839		3,066,298
Automobile service appliances	1,016	584,485	1,444	174,843	14,581	5,095,577	12,796	4,885,328
Airplanes, seaplanes and other aircraft	43	833,371	54	2,459,529	1,098	46,974,410	729	33,846,597
Parts of airplanes, except engines and tires		577,783		1,665,261		5,581,056		18,048,341
INTERNAL COMBUSTION ENGINES								
Stationary and Portable								
Diesel and semi-Diesel	51	315,323	70	178,193	452	1,775,930	437	1,775,651
Other stationary and portable								
Not over 10 hp.	1,916	93,466	2,190	94,739	12,815	728,233	13,698	731,629
Over 10 hp.	205	93,208	113	65,488	1,719	1,052,015	2,998	1,378,242
Engines for:								
Motor trucks and buses	2,324	259,781	219	32,903	22,724	2,773,909	21,081	2,341,835
Passenger cars	941	87,347	271	21,671	20,178	1,808,243	32,052	2,609,191
Aircraft	57	259,516	123	777,600	1,355	9,443,221	1,074	6,244,856
Accessories and parts (carburetors)		255,510		210,882		2,416,017		2,274,849
IMPORTS								
Automobiles (dutiable)	73	67,306	64	30,866	527	402,109	492	322,063

U. of N. Tests On Tractors

Among tractors recently tested by the University of Nebraska were the McCormick-Deering Farmall A, running on gasoline (Test No. 329); the McCormick-Deering Farmall A, running on distillate (330); the McCormick-Deering Farmall B, running on gasoline (331); the McCormick-Deering Farmall B, running on distillate (332); and the McCormick-Deering Farmall H, running on gasoline (333). The maximum permissible ratings of these various tractors are as follows: Farmall A, on gasoline: 13.01 drawbar, 16.20 belt; Farmall A on distillate, 11.65 drawbar, 14.55 belt; Farmall B on gasoline, 12.98 drawbar, 16.34 belt; Farmall B on distillate, 11.47 drawbar, 14.20 belt; Farmall H on gasoline, 19.13 drawbar, 23.72 belt. The gasoline used in the tests was of 71 octane and the minimum specific consumption was 0.515 lb. per hp-hr. in the case of Farmall A; 0.519 lb. per hp-hr. in the case of Farmall B; and 0.527 lb. per hp-hr. in the case of Farmall H. The distillate used was of 37 octane and the minimum specific consumption was 0.579 lb. per hp-hr. in the case of Farmall A and 0.583 lb. per hp-hr. in that of Farmall B. With high-test gasoline the average gain in maximum power over distillate was 13 per cent, and the average decrease in minimum specific consumption, 11 per cent.

Machine Tool Activity At 84.9% of Capacity

October operating activity in the machine tool industry, as reported by the National Machine Tool Builders' Association, stood at 84.9 per cent of capacity. This compares with 74.6 per cent in September and 52.5 per cent in January of this year.

Casing Shipments Continue Increase

Shipments of automotive casings during October, 1939, are estimated to have been 5,187,942 units, according to the Rubber Manufacturers Association. This is 7.7 per cent lower than the 5,621,088 units shipped during September, but is 25.7 per cent over shipments for October, 1938.

Shipments of casings for original equipment purposes are estimated by the association to have been 1,804,648 units, an increase of 45.3 per cent over September, and 40.2 per cent over October, 1938. These shipments were higher than any other October shipments since 1925. October production, estimated at 5,430,679 units, was 8.5 per cent higher than September and 29.8 per cent more than October, 1938.

Automotive casings in the hands of manufacturers Oct. 31 are estimated to have been 8,656,821 units. This represents an increase of 3.5 per cent over Sept. 30 stock and 5.1 per cent over the Oct. 31, 1938, inventory.

Producer Gas in the Limelight in England

It has been announced in England that before the end of the year an increasing number of buses will be running in London on producer gas, the plant carried on a small pneumatic-tired trailer. Experiments are said to have been in progress for a long while past, organized by a committee comprising representatives of the Fuel Research Station of the Department of Scientific and Industrial Research, the Ministry of Transport and Mines Department, and technical officers of several important road transport companies, including the London Passenger Transport Board, which operates the London buses as well as the Underground and Metropolitan Railways.

As a result the committee has developed a plant for existing buses and designed to be carried on a trailer, thus avoiding structural alterations of the bus. As stated, this is the scheme adopted for London buses to be run on producer gas, though an alternative has also been under test, consisting of an overhanging framework at the rear of the chassis to carry the plant.

It is stated that the equipment as developed by the committee for trailer use can be made at low cost and on a quantity production basis, and manufacturing concerns are offered every facility to enable them to put it into production for trucks as well as buses, carried either on a trailer or in modified form, on the vehicle itself. The weight of the plant and trailer is approximately 900 lb. without fuel; the latter, when the gas generator is fully charged, weighs about 350 lb., giving a double-deck bus a range of 160-170 miles without recharging.

Anthracite coal or low temperature coke can be used as the basic fuel. To encourage operators of buses in other cities than London, and truck operators, to adopt producer gas and thus reduce the demand for imported liquid fuels, the Government has promised not to ration or tax any basic fuel and not to include the weight of the plant when the vehicle is weighed for taxation rating. Already a regulation has been issued permitting public passenger vehicles to draw a trailer, for hitherto this has been prohibited in England.

In regard to performance, it is admitted that producer gas reduces the power output of a given engine by about 40 per cent. This drawback was said by the operating engineer of the Glasgow bus service to result in drivers being unable to keep to the schedule of the gasoline and oil buses; for three weeks before this he said he had been running in Glasgow a producer gas bus that had been built by the Highland Transport Co., Aberdeen, and operated for twelve months in a country service, with fuel economy in the ratio of 0.7 to 1.8 per mile as compared with gasoline.

MEMA Index Shows Continued Upswing

October figures of manufacturers reporting to the Motor and Equipment Manufacturers Association showed a continued rise in shipments of original equipment to vehicle manufacturers, service parts to wholesalers and accessories to wholesalers. Service parts shipments to wholesalers showed a decline from September, but was slightly above October, 1938.

Index of original equipment shipments to vehicle manufacturers for October was set at 159 (January, 1925, taken to equal 100), which was 30 points above October, 1938. Grand index of all divisions, at 146, indicated a rise of 13 points above October, 1938, and 18 points above September of this year.

Business in Brief

***Written by the Guaranty Trust Co., New York, Exclusively for* AUTOMOTIVE INDUSTRIES**

A slight recession in general business activity during the last fortnight is indicated. *The New York Times* seasonally adjusted index registered for the week ended November 18 the first decline in fifteen weeks and for the succeeding weekly period stands at 105.6 per cent of the estimated normal, as compared with 107.2 two weeks earlier. *The Journal of Commerce* unadjusted index for the week ended November 25 declined to 103.4 per cent of the 1927-29 average from 108.0 a fortnight before.

Retail sales during the week ended November 25, the largest weekly volume so far this year, ranged from 8 to 13 per cent above corresponding 1938 levels, according to the Dun & Bradstreet estimates. Department store sales during the four-week period then ended, as reported to the Board of Governors of the Federal Reserve System, were 7 per cent more than the total a year ago.

Production of electricity by the light and power industry during the week ended November 25, slightly less than in each of the preceding two weeks, was 13.6 per cent greater than a year ago.

The movement of railway freight declined more than seasonally in the same period, reflecting the observance of Thanksgiving Day. Loadings totaled 676,516 cars, 12.3 per cent fewer than for the preceding week but 20.4 per cent more than during the corresponding week last year.

Bank debits to individual accounts in leading cities during the week ended Nov. 22 were 4 per cent above the total for the preceding week and 10 per cent greater than a year ago.

Business failures during the week ended Nov. 23 numbered 191, the same as a year ago but 32 fewer than in the week before, according to the report of Dun & Bradstreet, Inc.

Crude oil production during the week ended Nov. 25 rose to an average of 3,818,100 barrels daily, 226,100 barrels more than in the week before and 198,100 barrels above the required output as computed by the Bureau of Mines.

Average daily production of bituminous coal during the same period was 1,600,000 tons, as compared with 1,637,000 tons for the preceding week and 1,533,000 tons a year ago.

With engineering construction contracts awarded for private projects during the final week of November exceeding by 53 per cent the comparable 1938 figure, as against a decline of 33 per cent for public work, the total was 16 per cent smaller than that a year ago, according to *Engineering News-Record*. The total for eleven months this year was larger than for the whole of 1938.

Cotton-mill activity increased more than seasonally during the week ended Nov. 25, *The New York Times* index rising to 141.1, as against 135.2 a fortnight earlier and 126.6 a year ago.

Professor Fisher's index of wholesale commodity prices for the week ended Dec. 2, establishing a new 1939 peak, stands at 84.7 per cent of the 1926 average, as against a low of 77.8 for the third week of August.

Excess reserves of the member banks of the Federal Reserve system declined $30,000,000 in the week ended Nov. 29 to an estimated total of $5,140,000,000, or $390,000,000 less than the all-time peak reached five weeks ago. Business loans of the reporting members a week earlier totaled $4,388,000,000, or $519,000,000 more than the corresponding amount last year.

PUBLICATIONS

Two new pamphlets have been published by John S. Barnes Corp. One describes Barnes **gear pumps,** PA-20 series; the other Barnes **piston pumps** for hydraulics, PA-14, 16, 17, 18 series.*

A 15-page illustrated booklet, issued by Foxboro Co., provides complete data on the company's **potentiometer recording pyrometers.***

Hobart Brothers Co. have released a booklet covering a complete line of **welding accessories and electrodes.***

Hauck Manufacturing Co. has issued a bulletin (No. 1034) covering two new Hauck **fire guns.***

Three new booklets have been released by General Electric Co. GEA-1758B covers a complete line of **rectangular switchboard instruments.** GEA-246F covers **high-speed synchronous motors** "7500 series". GEA-1784B covers **portable instruments.***

A new line of **turbine well pumps** is described in bulletin H-450-B29 of Worthington Pump and Machinery Corp. Another bulletin, H-450-B30, deals particularly with the vacuum molded impellers used in these pumps.*

Four Wheel Drive Auto Co. announces the publication of its handbook—**Truck and Trailer Size and Weight Restrictions for 1940.***

A catalog sheet by Electric Service Supplies Co. concerns a new **dolly to facilitate the removal of front and rear wheels of heavy automotive vehicles.***

Latest piece of literature of the White Motor Co. is a 36-page story of the development of its **"White Horse" trucks.***

The **application of ball bearings to the crankshaft of a small air-cooled single cylinder engine** is the subject of a new page issued to holders of New Departure ring binders of Automotive Bearing Applications.*

(Top of next column)

New Passenger Car Registrations—10 Months

	OCTOBER 1939	SEPT. 1939	OCTOBER 1938	TEN MONTHS 1939	TEN MONTHS 1938	Per Cent Change, 10 Months, 1939 over 1938	Per Cent of Total Ten Months 1939	Per Cent of Total Ten Months 1938	TWELVE MONTHS MODEL YEAR 1939	TWELVE MONTHS MODEL YEAR 1938	TWELVE MONTHS MODEL YEAR Per Cent Change
Chevrolet	25,246	24,099	22,913	474,002	360,353	+ 31.6	21.80	24.63	577,986	465,768	+ 24.0
Ford	34,500	18,948	13,959	390,206	297,102	+ 31.3	17.94	20.31	456,792	344,472	+ 32.7
Plymouth	37,566	27,943	29,897	320,160	218,949	+ 46.1	14.72	14.96	387,452	268,628	+ 44.0
Buick	23,522	9,206	18,155	167,547	128,549	+ 30.3	7.70	8.78	205,378	162,357	+ 26.2
Dodge	13,773	10,153	3,578	163,239	76,812	+112.5	7.50	5.25	191,308	102,423	+ 86.8
Pontiac	14,180	7,248	6,064	123,587	72,659	+ 70.0	5.68	4.97	149,327	95,546	+ 56.0
Oldsmobile	13,188	6,369	3,159	112,835	66,995	+ 68.0	5.19	4.58	138,238	87,144	+ 58.2
Studebaker	8,576	7,778	5,405	67,497	32,036	+110.5	3.10	2.19	76,965	39,737	+ 94.0
Chrysler	6,183	3,340	1,769	58,078	35,387	+ 64.0	2.67	2.42	68,875	47,750	+ 44.0
Mercury	4,321	3,397		51,755			2.38		58,590		
Packard	8,286	6,796	4,613	47,178	40,096	+ 18.0	2.17	2.74	56,245	50,905	+ 10.6
De Soto	4,727	3,620	1,388	47,018	27,174	+ 73.8	2.16	1.86	55,103	36,357	+ 52.0
Hudson	8,240	4,886	2,509	46,513	31,482	+ 47.6	2.14	2.15	55,920	40,751	+ 37.1
Nash	4,283	3,770	1,620	44,429	26,210	+ 69.2	2.04	1.79	50,033	33,556	+ 49.3
La Salle	1,541	837	1,246	16,995	11,128	+ 52.9	.78	.76	21,599	14,567	+ 48.5
Lincoln	1,271	1,086	816	15,914	13,629	+ 16.8	.73	.93	19,276	17,079	+ 12.8
Willys-Overland	1,864	942	1,139	10,810	11,090	- 2.2	.50	.76	12,732	15,543	- 18.0
Cadillac	960	656	493	10,344	7,983	+ 30.0	.48	.55	13,000	9,240	+ 40.8
Graham	142	225	188	3,552	3,425	+ 3.7	.16	.23	4,266	4,785	- 10.7
Bantam	101	119		1,076			.05		1,076		
Crosley	51	109		1,054			.05		1,054		
Hupmobile	20	51	46	887	919	- 3.4	.04	.06	988	1,025	- 3.6
Fiat	3	4		77					77		
Miscellaneous	42	51	96	509	1,217	- 58.1	.02	.08	815	1,663	- 51.0
Total	212,586	141,633	119,053	2,175,262	1,463,195	+ 48.8	100.00	100.00	2,603,095	1,839,296	+ 41.4
Chrysler Corp.	62,249	45,056	36,632	588,495	358,322	+ 64.0	27.05	24.49	702,738	455,158	+ 54.2
Ford Motors Corp.	40,092	23,431	14,775	457,875	310,731	+ 47.7	21.05	21.24	534,658	361,551	+ 48.0
General Motors Corp.	78,637	48,415	52,030	905,310	647,667	+ 40.0	41.62	44.26	1,105,528	834,622	+ 32.7
All Others	31,608	24,731	15,616	223,582	146,475	+ 52.5	10.28	10.01	260,171	187,965	+ 38.2

Catalog 1100B by C. J. Tagliabue Mfg. Co. covers the company's line of TAG laboratory thermometers and hydrometers.*

"Pertinent Facts About Continental Motors" is the title of a booklet recently issued by Continental Motors Corp.*

* Obtainable from editorial department, AUTOMOTIVE INDUSTRIES. Address Chestnut and 56th Sts., Philadelphia.

Trade Barriers

(*Continued from page* 643)

merce Department's Industrial Economics Division, who was appointed chairman of the committee, Mr. Hopkins will try to sell Senator Joseph E. O'Mahoney on the Hopkins' proposal to have the Temporary National Economic Committee hold hearings on the subject "to present evidence of the economic effects of present-day state laws which obstruct the free flow of commerce." Chairman O'Mahoney is expected to comply with the request.

As outlined by Mr. Hopkins, the committee would serve as a clearing house for information relative to developments in state trade barriers and would encourage cooperation in research and study of the economic effects of such laws and regulations.

"In the past few years," the Secretary of Commerce said, in a statement explaining his move, "the problem of interstate barriers to free trade between the several states has grown to be a serious threat to the economic life and business well-being of our Country. It has resulted in loss of business generally.

"The Department of Commerce, the Council of State Governments, other Federal agencies, state organizations and civic groups are fully aware of the far-reaching evils of these many laws and regulations tending to strangle trade and commerce.

"I feel that the objective for both the Federal and State Governments should be to strive for coordination in State and Federal laws which will permit a free flow of interstate commerce consistent with such regulatory functions as are necessary."

Westinghouse Adds Sealed Beam Lamp

Sealed beam auxiliary type headlights have been announced by Westinghouse Electric & Manufacturing Co. Four lamps will comprise the line. The new lamps will be designed to supplement rather than replace present headlighting equipment on older cars whose lighting systems are inadequate to handle the approximately 50 per cent more wattage required by standard sealed beam lamps. Two auxiliary lamps, to be known as the Mazda Sealed Driving Lamp and the Mazda Sealed Passing Lamp, will be ready in the near future, the company reports. Two others, a fog lamp and a spot lamp, will be added to the line later.

Photo from Bettman Archives

Not as Ridiculous

English car owners, terming as ridiculous gasoline rations limiting civilian consumption when storage tanks are filled to capacity and tankers are unable to find space to unload their cargoes, are still not as hampered as the car owner of 1894. The first car in England was a Benz owned by Mr. Harry Hewetson. Mr. Hewetson was warned that he could not use his car because of the law which required that all mechanically propelled vehicles had to be preceded by a man with a red flag. Accordingly, as is shown in this drawing by A. Forestier, the owner sent a bicycle scout ahead and had with him in the car a little boy who, when the scout reported a policeman, got down and carried the flag. The flag was only a tiny scrap of red ribbon on a lead pencil, but it fulfilled the law.

England's Motorists Protest "Unnecessary" Gas Rationing

New Diesel; Aluminum Shortage; Dealers Hit by Used Car Slump

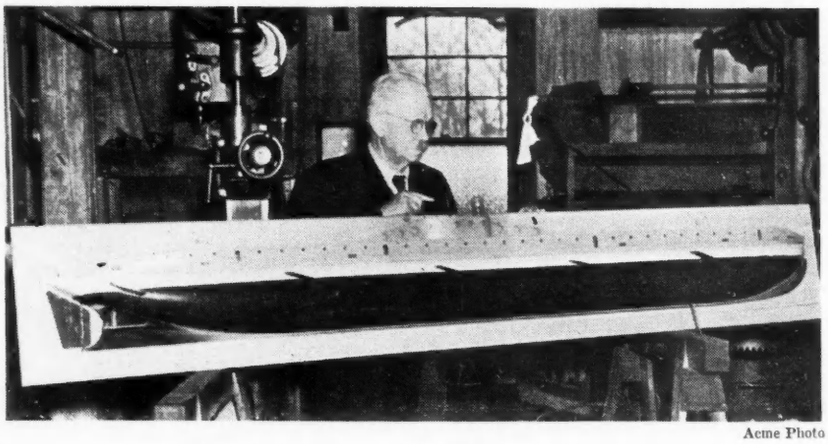
England's war time regulations and restrictions have hit car manufacturer, car dealer and car owner alike. While citizens of that country appreciate the necessity of manufacturers turning their productive power to army orders, they fail to see eye-to-eye with the government when it comes to meager rationing of gasoline. Public protests are becoming more numerous and forcible concerning the gasoline rations. A deputation from the motor industry is to interview the Minister of Mines on the subject. It will be urged that rationing has reduced the consumption of gasoline for civilian purposes by nearly 75 per cent; and quite unnecessarily, for every storage tank is full to capacity and tankers are constantly held up in port unable to discharge their cargoes.

A demand will be made that the ration should be doubled before the end of the year, otherwise at least 50 per cent of the cars now licensed will be laid up; for on top of the rationed gasoline there will be an increase of tax from $2.93 to $4.88 per hp. on Jan. 1. This will mean ruination for a large proportion of garage proprietors it is expected, for already there are 30 per cent fewer cars in use, judging by the license renewals on Oct. 1 for the last quarter of the year.

The gross profit margin on gasoline has been reduced, and with overheads increasing it is contended that gasoline sales are now being carried on at a loss. The profit margin has gone down while the price has gone up; a second rise since the war started has put the price up to 35 cents per gal., against 30 cents in September. The price is now the highest for 16 years, though in 1920 it was 77 cents per gal.

With new car production seriously affected, dealers find added to their troubles a drop in sales prices of used cars. Repossessions by finance companies are said to be reponsible in part for the slump in used car values since early September, and dealers are in a quandary when prospective buyers of new cars—of whom there are still quite a fair number—want a part-exchange deal. Some dealers are refusing trade-ins entirely. Others are offering

(*Turn to page* 651, *please*)



Acme Photo

Submarines to Avoid Submarines

Simon Lake, inventor of the submarine, is shown in his Milford, Conn., laboratory with a model of the cargo carrying submarine he proposes as the solution for safe blockade running. Pointing to the successful voyage of the German "Deutschland" which carried a 500-ton cargo to the U. S. and returned safely during the first World War, Mr. Lake asserts it would now be possible to duplicate its feat in under-sea freighters of 13,000 ton cargo capacity. Such vessels, 400 ft. long with a beam of 70 ft., travelling with only periscope and air intake above the surface at a top speed of 12 knots (slightly better than most freighters) would, said Mr. Lake, be practically invisible and safe from ship blockades and attacks by enemy submarines. Submarines of this type, Mr. Lake avers, could be built in three months and would be valuable in peace times for penetrating harbors locked with ice.

They Also Serve . . .

Our English contemporaries, laboring under severe wartime handicaps of economy and censorship, are developing an ingenuity for creating editorial material of interest. We sadly watched such stalwarts as *The Autocar* and *The Motor* shrink to mere blackout instruction pamphlets, and note with pleasure more recent evidence of constructive efforts on behalf of the industry.

A neat example of what we have in mind is the editorial published in an issue of *The Motor*, just received. It points out that notwithstanding the increased horsepower tax which is effective Jan. 1, and despite the rationing of fuel that private motorists should continue to use their cars even if only for recreative purposes.

"Remember," states the editorial, "that the motor industry is our third largest; that taxation on motor vehicles and motor fuel alone produces one-tenth of the national revenue; and that the hundreds of thousands employed in the production, distribution, sale and servicing of private cars pay in the aggregate large sums in income tax and surtax. Sweep away this industry and put many people out of employment—would that be in the national interest?"—H.E.B., Jr.

Detroit's Place

(*Continued from page* 643)

any event, there will be no confusion, no overlapping of functions or orders, due to the earmarking program already in effect.

In the Detroit area, the motor vehicle producers already have been assigned specific tasks depending upon the nature and extent of their facilities. In some instances, the same establishment may be producing aircraft engines, army trucks, and ordnance.

A number of bottle-necks are anticipated in the event of war although their effect may not be evident for at least 18 months after the activity has begun. These are—shortage of specialized, single-purpose machine tools; skilled labor; power. It is anticipated that much of the production equipment required for the military program, under the conditions noted above, will have to be built in the Detroit area.

Some idea of the quantity of ordnance that may be required may be gained from Mr. Dow's statement that in one extraordinary 24 hour period during World War 1, the allied artillery fired 400,000 shells. At the present time the most advanced shell making equipment is rated at 100 per hour per machine per operator, with a separate machine per operation.

Among the major items of ordnance to be allocated to the Detroit area are the following: Small shells, machine guns, automatic pistols, gun carriages, caissons, recoil mechanism, and light tanks.

Monthly Motor Vehicle Production (U. S. and Canada)

	PASSENGER CARS		TRUCKS		TOTAL MOTOR VEHICLES	
	1939	1938	1939	1938	1939	1938
January	291,444	168,890	62,502	58,062	353,946	226,952
February	250,897	151,133	61,244	51,464	312,141	202,597
March	312,392	186,341	77,097	52,106	389,489	238,447
April	286,200	190,111	68,063	47,818	354,263	237,929
May	249,455	168,599	63,759	41,575	313,214	210,174
June	257,289	147,545	66,946	41,857	324,235	189,402
July	155,850	112,114	62,628	38,336	218,478	150,294
August	62,452	61,687	40,891	35,259	103,343	96,946
September	165,119	69,449	27,553	20,174	192,672	89,623
October	259,610	192,906	63,407	22,380	323,017	215,286
November	.....	335,767	.....	54,638	.....	390,405
December	.....	341,524	.....	65,492	.....	406,960
Total	.....	2,126,066	.....	529,161	.....	2,655,171

Passenger Car and Truck Production

(U. S. and Canada)

	October 1939	September 1939	October 1938	TEN MONTHS 1939	TEN MONTHS 1938	TEN MONTHS Per Cent Change
Passenger Cars—U. S. and Canada						
Domestic Market—U. S.	239,150	155,430	171,371	2,071,710	1,209,563	+71.3
Foreign Market—U. S.	12,669	6,195	16,123	136,007	145,072	− 6.2
Canada	7,791	3,494	5,412	87,433	94,140	− 7.2
Total	259,610	165,119	192,906	2,295,150	1,448,775	+58.6
Trucks—U. S. and Canada						
Domestic Market—U. S.	50,888	20,772	16,697	443,271	265,291	+67.1
Foreign Market—U. S.	10,670	6,354	5,321	122,264	108,400	+13.0
Canada	1,849	427	362	32,493	35,340	− 8.0
Total	63,407	27,553	22,380	598,028	409,031	+46.1
Total—Domestic Market—U. S.	290,038	176,202	188,068	2,514,981	1,474,854	+70.3
Total—Foreign Market—U. S.	23,339	12,549	21,444	258,271	253,472	+ 2.0
Total—Canada	9,640	3,921	5,774	119,926	129,480	− 7.5
Total—Cars and Trucks—U. S. and Canada	323,017	192,672	215,286	2,893,178	1,857,806	+55.8

Ourselves & Government

A Check List of Federal Action Corrected to Dec. 8

LABOR DEPARTMENT

Employees who make tools and dies which are used in the production of goods for interstate commerce, even though the tools and dies themselves do not move in interstate commerce, were brought under the provisions of the Fair Labor Standards Act on Nov. 24, when George A. McNulty, general counsel of the Labor Department's wage-hour division issued the latest interpretative bulletin.

NATIONAL LABOR RELATIONS BOARD

The Board has announced certification of International Union, United Automobile Workers of America, AFL affiliate, as the sole collective bargaining agency selected by a majority of the production and maintenance employees at the Chrysler Corporation's Evansville, Ind., plant, and dismissed the petition for investigation and certification of representatives filed by International Union, United Automobile Workers of America, CIO affiliate in so far as it related to employees of the Chrysler Corp. at its Kokomo plant. Board action was based upon results of secret ballot elections held Sept. 27-28, resulting in a count of 335 votes for the AFL group and 307 votes for the CIO group at the Evansville plant; and 173 votes for the CIO group, 17 votes for the AFL group, and 343 votes for neither at the Kokomo plant.

AUTOMOTIVE INDUSTRIES

Summary of Automotive Production Activity

BUSES Inquiries for new equipment for Pacific Coast cities, several western communities, and possible revamping of New York bus equipment are reported.

TRUCKS Manufacturers encouraged with prospects for 1940 and expect business to be better than the several years past. Deliveries at present continue to run ahead of same period last year.

TRACTORS Shipments from factories to dealers high. Prospects encouraging for 1940 output.

AUTOMOBILES Output of cars and trucks for first half of December estimated at 238,000 units. If present pace holds, the month's production should be fairly close to 440,000. Production figures reflecting an immediate response to settlement of Chrysler strike.

MARINE ENGINES Marked increase in foreign orders reported. Sales appear to be tapering off in anticipation of annual Motor Boat Show, opening in New York, Jan. 5.

AIRCRAFT ENGINES Production of powerplants and engine accessories running under heavy schedules, with backlogs of orders continually piling up.

This summary is based on confidential information of current actual production rates from leading producers in each field covered. Staff members in Detroit, Chicago, New York and Philadelphia collect the basic information, in all cases from official factory sources.

(Copyright 1939, Chilton Co., Inc.)

Truck Production by Capacities

(U. S. and Canada)

	TEN MONTHS			Per Cent of Total	
	1939	1938	Per Cent Change	1939	1938
1½ Tons and less	547,657	377,948	+ 45.0	91.58	92.41
2 to 3 Tons	28,553	15,968	+ 78.8	4.77	3.90
3½ Tons and over	11,350	7,783	+ 46.0	1.90	1.90
Special and buses	10,468	7,332	+ 42.7	1.75	1.79
Total	598,028	409,031	+ 46.2	100.00	100.00

New Truck Registrations

	October 1939	September 1939	October 1938	TEN MONTHS 1939	TEN MONTHS 1938	Per Cent Change, 10 Months 1939 over 1938	Per Cent of Total Ten Months 1939	Per Cent of Total Ten Months 1938
Chevrolet	13,091	9,132	3,828	140,865	98,021	+ 43.3	34.53	31.63
Ford	7,694	7,288	4,966	105,045	86,725	+ 21.0	25.75	27.98
International	7,136	6,297	5,104	55,955	47,816	+ 17.0	13.71	15.43
Dodge	3,244	4,169	1,564	43,741	29,970	+ 46.0	10.72	9.67
G. M. C.	3,188	3,091	1,306	28,754	17,172	+ 67.4	7.05	5.54
Plymouth	515	439	306	7,621	6,170	+ 23.3	1.87	1.99
Mack	774	556	512	5,563	3,493	+ 59.5	1.36	1.13
Diamond T	570	496	419	4,382	3,757	+ 16.9	1.07	1.21
White	455	483	291	3,865	2,924	+ 32.0	.95	.94
Studebaker	162	165	162	1,874	1,695	+ 10.6	.46	.55
Autocar	183	191	135	1,781	1,364	+ 30.5	.44	.44
Brockway	181	157	135	1,540	1,077	+ 43.2	.38	.35
Federal	251	159	100	1,418	1,171	+ 21.0	.35	.38
Willys-Overland	145	99	140	1,298	1,668	− 22.1	.32	.54
Divco	117	64	76	1,163	1,045	+ 11.3	.28	.34
Reo	20	18	285	837	2,503	− 66.5	.20	.81
Bantam	55	59		501			.12	
Hudson	10	11	26	366	660	− 44.5	.09	.21
Sterling	26	23	19	280	209	+ 34.0	.07	.07
Indiana	9	14	26	162	380	− 57.4	.04	.12
F. W. D.	9	12	13	146	248	− 41.1	.04	.08
Miscellaneous	88	60	176	845	1,864	− 54.7	.20	.59
Total	37,923	32,983	19,589	408,002	309,932	+ 31.8	100.00	100.00

FEDERAL TRADE COMMISSION

F.O.B. PRICE CASE — Trial examiners' hearing held in Ford case in Detroit on Nov. 2. Next step will be trial examiners' report. Testimony closed in GM case, with trial examiners' report having been served on respondent company. After final arguments, the FTC order is next in line. Both cases involve the FTC allegation that the companies engaged in misleading price advertising.

VS. GENERAL MOTORS—Trial examiners' report due. Rebuttal testimony concluded Sept. 11. The FTC charge is that GM dealers are required to handle GM parts exclusively.

SIX PER CENT CASE—Final arguments completed in both Ford and GM cases involving the Commission allegation that companies engaged in misleading representation in finance plan advertising. Cease and desist orders may be next development.

FAIR TRADE PRACTICE RULES —No indication when rules, now long overdue, will be promulgated.

MEN . . . . . .

T. H. Belling has been appointed general sales manager of Fleming Manufacturing Co. For the past five years he has been Chicago branch manager for both Black & Decker and Van Dorn Mfg. Co.

At the annual stockholders meeting, the following were elected officers of United Specialties Co.: **J. T. Beatty**, president; **M. D. Harrison**, secretary and treasurer; **A. V. Meulen**, assistant secretary and assistant treasurer. Di-

(*Turn to page* 650, *please*)

Chrysler Strike Caused Loss of More than $100,000,000 in Sales

Company's Workers Resume Jobs After Losing $15,000,000 in Wages

Chrysler plants in Detroit resumed operations on Nov. 30 after settlement of the prolonged 54-day strike which had established a new high record for labor difficulties in the automotive industry's strike bestrewn record of the past three years. Other Chrysler plants will resume operations just as soon as the normal flow of production could be started. As a result it was expected that December car and truck production would average well over 100,000 units weekly for the industry.

Features of the settlement were a general three cents an hour raise in pay, establishment of a four-man arbitration board to settle all major disputes deadlocked through the grievance procedure, changes in wage rate classifications, revisions of seniority provisions, and prohibition of strikes until all grievance procedure has been exhausted including sitdown and slowdown strikes. The new contract will run until Nov. 30, 1940, and is subject to renewal at that time unless either side files notice between Nov. 1 and 15 of desired amendments.

Although the settlement was hailed as a victory by UAW-CIO leaders their jubilation was heavily overshadowed by general realization of the tremendous cost of the dispute to all parties concerned, including the Chrysler dealer organization. It was estimated that the strike cost the corporation—and hence its dealer organization—over $100,000,000 in sales at the peak of the new model season. In addition the Chrysler workers lost $15,000,000 in wages. Against this the general three cents an hour raise in pay, with certain other wage adjustments for more skilled workers and those employed on other than day shift, provided Chrysler workers with an estimate increase in pay of approximately $5,000,000. Most of the demands originally made by the union at the beginning of the dispute were not granted.

ats heat!
MAN PUSHES TONS WITH EASE
Where, before, two and sometimes three men were required to push the car out of the kiln, now one man does the job - and estimates indicate a further saving of 25% in wheel maintenance.
This is the actual experience of a company whose production problem involved the lubrication of kiln car wheel bearings subjected to 450°F over three-day cycles and carrying a weight of from two to three tons. Ordinary heavy oil carbonized and "froze" the wheels; powdered graphite in kerosene helped, but settling of the large graphite particles in the carrier was encountered.
It was not until "dag" colloidal graphite dispersed in kerosene was used that the problem was solved. Excellent suspension, of course, was assured as was a solid lubricant which easily withstood the existing temperatures.
"Dag" colloidal graphite, dispersed in various fluids, is solving problems in many industries using high temperatures. Ask your oil supplier about his lubricants containing colloidal graphite and write us for 40 page brochure giving 182 applications of this product in industry.
dag
COLLOIDAL PRODUCTS
ACHESON COLLOIDS CORPORATION
PORT HURON, MICHIGAN

Men

(*Continued from page* 649)

rectors reelected were: **J. T. Beatty, M. D. Harrison, J. C. Markey, R. Maguire, R. N. Webster, E. K. Williams.**

Electric Auto-Lite Co. announces two appointments. **J. F. Joyce,** formerly midwest division manager of the merchandising division, has been appointed national account manager. **R. E. Behlen** has been appointed midwest division manager.

J. E. Gleason, president, Gleason Works, has been awarded the American Society of Mechanical Engineers' Gold Medal for 1939. The award, presented during the A.S.M.E. annual meeting, was made for "his distinguished services to the automotive industry by making possible better and safer gear drives."

The following have been elected to the board of directors of the Motor and Equipment Manufacturers Association: **R. B. Davis,** Raybestos division of Raybestos-Manhattan, Inc.; **E. A. Hall,** Hall Manufacturing Co.; **H. R. Kerans,** K-D Lamp Co.; **C. W. Reeve,** Kraeuter & Co.; **E. J. Rich,** Simonize Co.

G. H. Bell, associated with Willys-Overland Motors, Inc., since February, has been named assistant sales manager.

J. H. Howell, formerly in the sales department, has been appointed advertising manager of Cleveland Tractor Co.

40 YEARS AGO

We introduce a new maker of roller bearings—the Grant Axle & Wheel Co., Springfield, O. The roller bearing they manufacture is built on entirely different lines from all others in the market, the end thrust being taken care of by the conical rollers themselves instead of by an additional ball bearing, as is often employed for this purpose. The bearing is oil and water tight, requiring oiling but three or four times a year. Another advantage is a loose cone, so that an occasional jolt or jar will cause the cone to wear and bring the wear upon another part of it instead of concentrating all the wear on one part, as is the case when the cone is keyed to the spindle.

From *The Horseless Age*, Dec., 1899.

English Protest Gas Rationing

(*Continued from page* 647)

what they consider a "safe" figure, in the belief that values will rise in the spring of next year, particularly in the case of small cars. This view is by no means general, however, a more widely held opinion being that prices of used cars will slump still further after the end of the year, because of the many owners who will be trying to sell their cars instead of laying them up on account of the higher tax and meager petrol ration, if the latter is not increased.

The gasoline rationing system has turned the motorists to serious study of the use of substitute motor fuels. The county engineer of Middlesex, which includes a large part of London, has advised that plant should be installed at the county sewage works to recover the gas from the sludge, for use as a motor fuel. It would cost £7000 he estimates, and would enable the equivalent of gasoline worth £19,000 a year to be recovered for use in the county's fleet of motor vehicles. He points out that sewage-sludge gas containing 70 per cent of methane gives 40 per cent more power in a given engine than coal gas, and that its recovery and use would remove a difficulty now being experienced because it cannot be burned to waste during the black-out hours. Dr. C. M. Walter, of the Birmingham Gas Department, who is regarded as an authority on the subject of compressed gas as a motor fuel, is said to be enthusiastic regarding the proposal. The chief difficulty will be to obtain the necessary high-pressure cylinders for carrying the gas on the vehicles. This is also a stumbling block in the case of coal gas.

The makers of the Perkins high-speed Diesel engines, which are used by several British bus and truck manufacturers, have introduced a new model, a six-cylinder unit of 7.3 liters. It has a governed speed of 2000 r.p.m. for buses and 1800 r.p.m. for trucks, developing 115 and 105 b.hp., respectively, at these speeds. Like some other models of the Perkins range, the overhead valves are operated by a high camshaft in an oil-bath at the side of the cylinder block; there are no separate push-rods, but lengthened cam-followers in their stead. The specification includes a seven-bearing counter-weighted crankshaft with lead-bronze main and big-end bearings, C.A.V. fuel pump with pneumatic governor, vane type exhauster for servo braking, and oil-bath air filter. The cylinder head is of the air-cell type with a two-spray atomizer, one spray directed across the cell and the other down through the neck.

An aluminum shortage for civilian purposes is threatened and motor manufacturers are planning to dispense with it by the use of substitute materials, such as cast-iron for pistons and in place of the magnesium and other alloy crankcase hitherto a feature of many Diesel engines. Producers of aluminum have increased their outputs, but all available supplies are needed for airplanes and other military requirements.

"SERVICE PROVED" *lubricants gave it to* MEAD SCREW PRODUCTS COMPANY

D. C. Mead, pressed for time in filling an important customer's order, consulted Cities Service Lubrication Engineers. After a study of his problem, they recommended the correct Cities Service Cutting Lubricant—increasing his production speed 25%, lengthening cutting tool life and helping Mr. Mead turn out a better finish.

You, too, will find our Lubrication Engineering Service a help in turning out work that meets the demands of your most discriminating customers. This service offers you the culmination of a long and varied experience in the solving of many cutting oil problems—plus oils developed as a result of this experience. Let one of our Lubrication Engineers prove the value of these oils to you in your own operations. There is no obligation.

CITIES SERVICE
Cutting Oils
"SERVICE PROVED"

FREE! *Just Clip and Mail*

CITIES SERVICE OIL CO.
Sixty Wall Tower—Room 1626J, New York, N. Y.

Please send me a copy of your *free* folder "Metal Cutting Lubrication."

Name ..... *Title* .....
Business Address .....
Firm Name .....
City ..... *State* .....

F. C. Stevens

Frederic Cushing Stevens, vice-president and managing director of the printing division of the Chilton Co., died Dec. 1 in University Hospital, Columbus, Ohio, at the age of sixty-one from complications following an operation performed Nov. 30. He was prominent in the printing and publishing field in New York and Philadelphia and president of the Swetland Realty Co. While his business has been in Philadelphia for many years, he continued to maintain his residence at 325 West End Avenue, New York City.

Surviving him are his widow, Velma Swetland Stevens, daughter of the late Horace Monroe Swetland of New York; a son, Frederic C. Stevens, Jr., of New York; a daughter, Mrs. Richard F. Sater of Columbus, Ohio; four grandchildren, Verna P. Stevens, Frederic C. Stevens, 3d, Velma S. Sater and Frederic S. Sater, and a sister, Elizabeth Stevens, of Fredonia, N. Y.

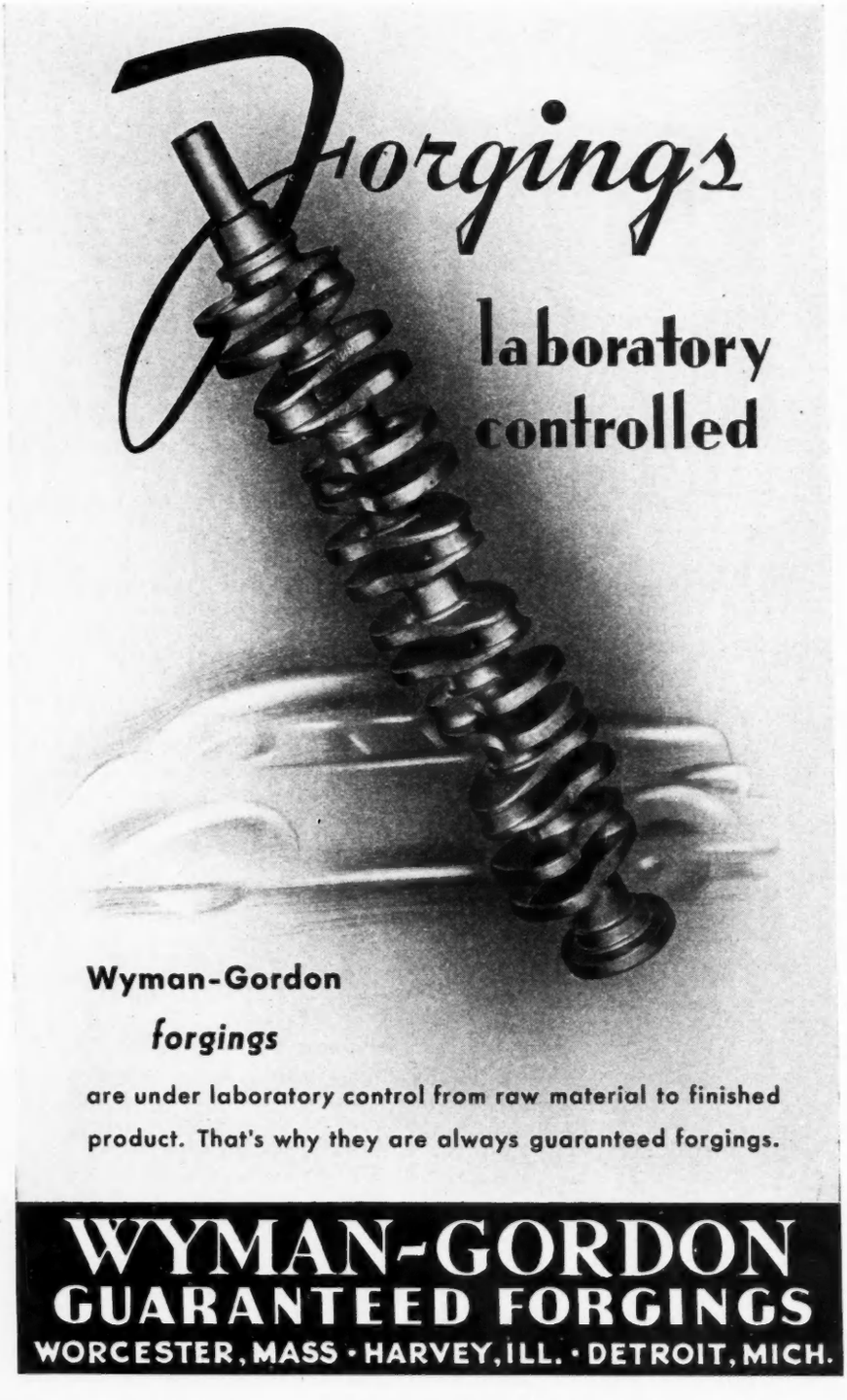
Frederic Cushing Stevens was born at Fredonia, Sept. 8, 1878, a son of Douglas Houghton and Sarah Parker Stevens. His early education was procured at the Fredonia State Normal School. He entered the Engineering College of the University of Michigan in 1899 and was graduated in 1903 with the degree of Bachelor of Science in Civil Engineering.

After a few months with the American Bridge Company, he entered the printing and publishing field in New York City, in which he continued during his entire business career. By successive stages, he was treasurer and manager of the Greenwich Printing Co., treasurer and manager of the Federal Printing Co., and president, treasurer and manager of the same company. He was also a director and treasurer of the United Publishers Corp., publishers of business papers, including *The Iron Age*, etc. These companies were consolidated with the Chilton Co. of Philadelphia and he was made managing director of the printing division and a vice president of the company.

He early became interested in organization work in the printing industry and was one of the founders of the Printers League. On the consolidation of the League, Master Printers Association and Printers Board of Trade to form the New York Employing Printers Association, he was made its second president in 1918 and 1919. He was also one of the founders of the Printers and Bookbinders Mutual Liability Insurance Co. and was treasurer of the company from its inception in 1914.

For many years a member of the West End Presbyterian Church, he was a member of the Board of Trustees and acted as treasurer for some years. He was also interested in New York City real estate, and since 1924 was president of the Swetland Realty Co.

He was a past member of Siwanoy Country Club, New York Athletic Club and Kingswood Country Club of Wolfboro, N. H. He was a member of Phi Gamma Delta Fraternity and of the Phi Gamma Delta Club of New York. He was a veteran of Company D, Seventh Regiment, New York City, and a member of the West End Association.



CALENDAR

Conventions and Meetings

National Aeronautic Association of the United States, Annual Convention, New Orleans, La.....Jan. 10
U. S. Chamber of Commerce, General Conference on Light and Signal Equipment .....Jan. 11-12
SAE Annual Meeting & Engineering Display, Book-Cadillac Hotel, Detroit .....Jan. 15-19
National Automobile Dealers' Association, Annual Convention, Washington, D. C. .....Jan. 22-25
American Road Builders' Association, Convention, Chicago.....Jan. 29-Feb. 2
Chamber of Commerce of the United States, Annual Convention, Washington, D. C.....April 30-May 2
American Society for Testing Materials, Annual Convention, Atlantic City, N. J. .....June 24-28

Shows at Home and Abroad

National Motor Boat Show, Grand Central Palace, New York.....Jan. 5-13

BILLIONS OF COPIES OF THE NEW YORK NEWS

ROLL OVER BANTAM BEARINGS

Bantam Roller Bearing used on both plate and impression cylinders of presses which print the NEWS. 5½ in. bore, 7½ in. O. D.

THE gigantic GOSS presses which print THE NEW YORK NEWS must deliver the world's largest newspaper circulation —nearly two million daily, over three million Sunday. In the Manhattan press room, a section of which is shown above, are 21 press units. In the Brooklyn plant are 30 additional units. These units may be combined to form presses capable of printing papers from 32 to 102 pages and each press delivers 48,000 complete issues per hour.

Bantam Roller Bearings are used on the two ton plate and impression cylinders of each press unit—408 Bantam Bearings in all. When these huge presses are "rolling" there's a combination of weight and speed which puts a tremendous strain on bearings. Yet —since 1931, when Bantams Bearings were first installed, there has been complete freedom from bearing trouble.

In these 8 years billions of copies of the NEWS have been run over Bantam Bearings without a single replacement! Just another example of the part Bantam engineers play in helping a wide range of industries solve tough friction problems vital to their successful operation.

BANTAM BEARINGS CORPORATION, South Bend, Indiana
Subsidiary of THE TORRINGTON CO., Torrington, Conn.

TAPERED ROLLER—STRAIGHT ROLLER—BALL

BANTAM BEARINGS

TO ALL BUILDERS OF MACHINES —TO ALL USERS OF MACHINES

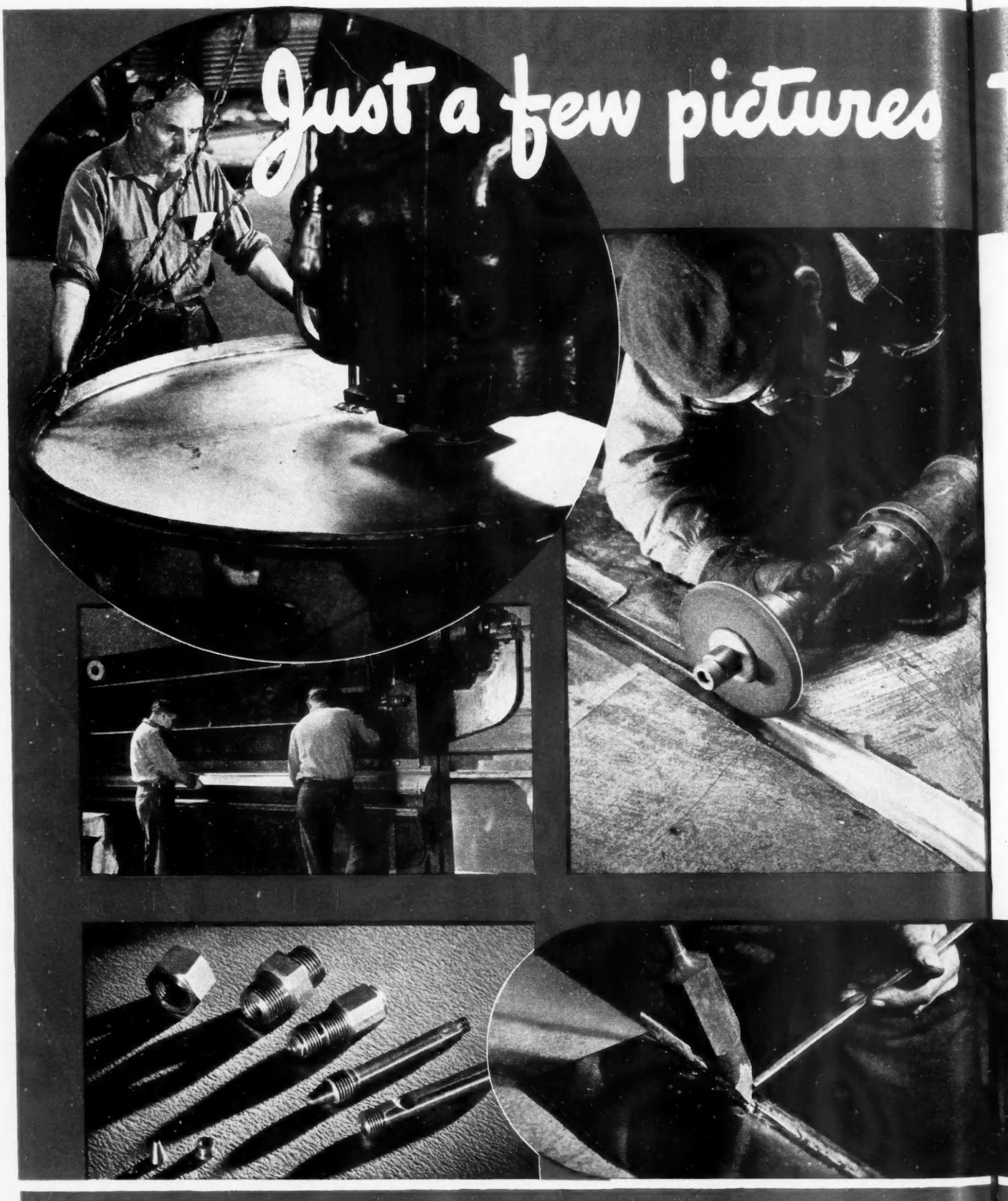
We proudly offer this story—a reprint of a recent ad in Time "news magazine." You will see what we mean when we say, "Bantam Bearings are really TOUGH."

408 Bantam Bearings on these giant Goss presses... rolling out many millions of newspapers during the past 8 years... without a single bearing failure! Goss design engineers were wise to select Bantam Bearings for these fastest-running newsprint presses in America.

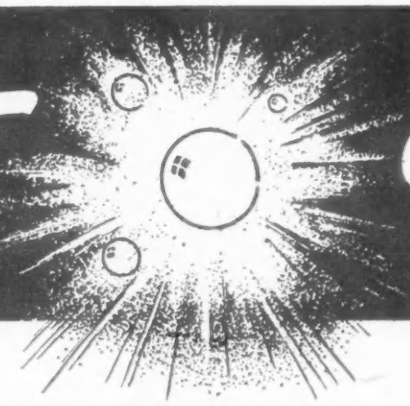
It is wise to select Bantam Bearings for ALL friction problems. Then, buyers and users of your machines, too, will share the good news — more years of service without breakdown on Bantam-equipped machines!

Bantam engineering service is at your disposal. Take advantage of our experience in applying all MAJOR TYPES OF BEARINGS.

BANTAM BEARINGS CORPORATION
SOUTH BEND, INDIANA
Subsidiary of THE TORRINGTON CO.
Torrington, Conn.


Just a few pictures
REPUBLIC ENDURO

to burst a bubble



Showing how ordinary tools and intelligence ... combined with Republic ENDURO Stainless Steel ... can be used to fabricate greater profits for Automotive Parts Manufacturers.

The old idea that the fabrication of stainless steel involved almost insurmountable difficulties is a myth easily dispelled by these photographs. They show two things — the many ways in which articles of ENDURO* may be fabricated, and the use of machines in common use in plants everywhere, even to the lowly soldering iron.

But these photographs show even more. They show the making of articles which will soon pass into other hands at a profit to the manufacturer — because there is an active ready market for the better products that ENDURO makes possible.

This modern metal of silvery lustre beautifies homes and business establishments — serves well in institutions and industrial plants. It resists rust, corrosion, and high temperatures. It is sanitary and easily cleaned. It withstands hard service and abuse — and best of all, its cost is low when figured on the years of service it renders.

In Republic's world-renowned laboratories, metallurgists have developed ENDURO Stainless Steel in many types — for every conceivable service. Getting the correct type may mean the difference between the success and failure of your product. Republic can help you there — and will also send you a copy of the new book, "The Fabrication of Republic ENDURO Stainless Steel," upon request.

REPUBLIC STEEL CORPORATION
GENERAL OFFICES • CLEVELAND, OHIO
ALLOY STEEL DIVISION • MASSILLON, OHIO

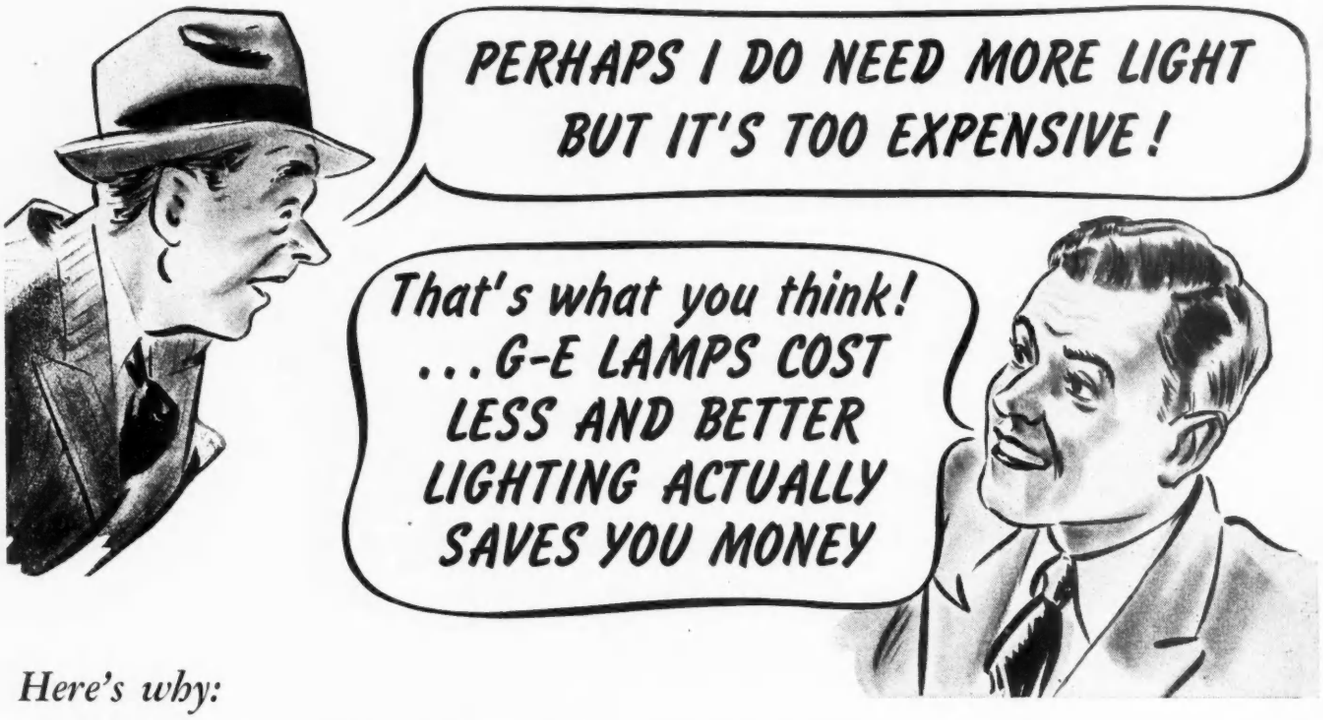
*Reg. U.S. Pat. Off.

BERGER MANUFACTURING DIVISION
NILES STEEL PRODUCTS DIVISION
STEEL AND TUBES DIVISION
UNION DRAWN STEEL DIVISION
TRUSCON STEEL COMPANY

REPUBLIC STEEL
REG. U. S. PAT. OFF.

stainless and heat-resisting STEELS

GENERAL ELECTRIC MAKES LAMPS FOR


PERHAPS I DO NEED MORE LIGHT BUT IT'S TOO EXPENSIVE!
That's what you think! ...G-E LAMPS COST LESS AND BETTER LIGHTING ACTUALLY SAVES YOU MONEY

Here's why:

1. G-E LAMPS GIVE MORE LIGHT FOR LESS MONEY because scientific research and development year after year are producing lamps which operate at constantly greater efficiencies, yet sell at continually lower prices.

2. G-E MAKES A COMPLETE LINE OF LAMPS . . . representing *every* type of electric lamp practical to industry. This fact assures you of an unbiased recommendation for lighting to fit every need.

3. SIXTY YEARS OF MANUFACTURING and application experience is back of every lamp General Electric makes. Many of these lamps must pass as many as 480 checks, tests, and inspections to assure satisfactory performance.

4. G-E's SYSTEM OF STRATEGICALLY located warehouses, supplemented by wholesalers' stocks, practically assures 24-hour delivery anywhere in the United States. This saves you time and storage space.

5. G-E's LIGHTING ENGINEERING SERVICE at Nela Park and in 17 key cities offers you its wealth of knowledge in solving lighting problems and in helping you get the most for your lighting dollar. It's yours for the asking.

• • •

For specific information, write the General Electric Lamp Division nearest you, or Nela Park, Cleveland, Ohio.

Get these benefits by light-conditioning your plant with G-E lamps!

Let a G-E Lighting Specialist show you how light-conditioning can improve working conditions and actually help increase profits by:

1. Increasing efficiency of operation.
2. Providing means for more accurate work.
3. Effecting more efficient maintenance of equipment.
4. Conserving eyesight.
5. Reducing accidents.
6. Improving morale because of brighter more cheerful working conditions.

• • •

For further information, write General Electric Company, Lamp Department, 166-AI-L, Nela Park, Cleveland, Ohio.

GENERAL ELECTRIC

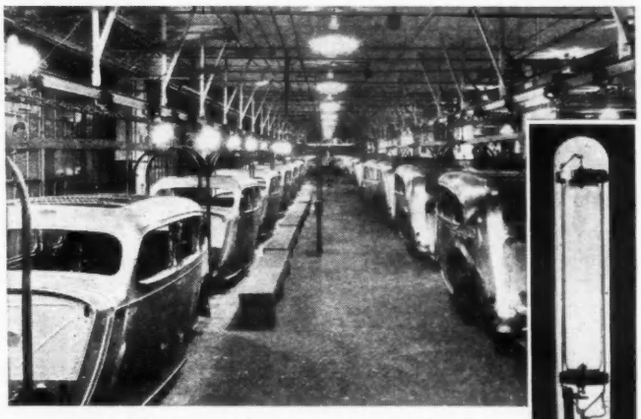
LAMP DEPARTMENT, NELA PARK, CLEVELAND, OHIO

EVERY INDUSTRIAL LIGHTING NEED!

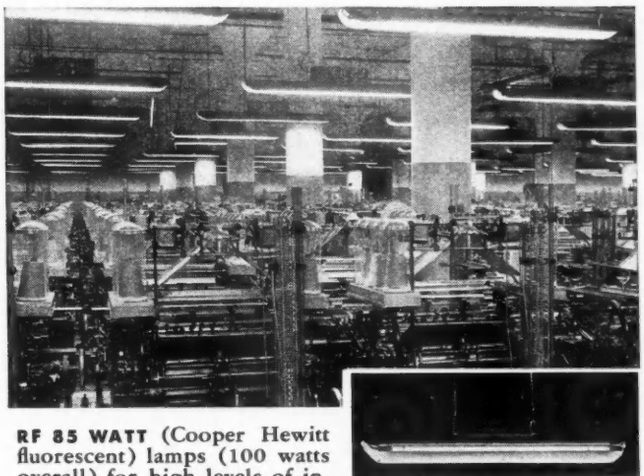
G-E MAZDA filament lamps fulfill most industrial requirements for general lighting service. They are made in sizes from 15 up to 1500 watts, and available in certain sizes in clear, inside frosted, white bowl, silvered bowl, and daylight bulbs.

G-E MAZDA Projector lamps concentrate light where it's needed. Lens, reflector, and filament are one sealed unit.

G-E MAZDA F (fluorescent) lamps make possible higher lighting levels and are 50% cooler than filament lamps. Available in daylight, white, and five colors, in several lengths and wattages.



G-E MAZDA H (mercury) lamps—400 watt size shown—have high efficiency, long life and ruggedness—very practical for high bay areas. May be used advantageously either alone or in combination with filament lamps.



RF 85 WATT (Cooper Hewitt fluorescent) lamps (100 watts overall) for high levels of industrial illumination. Make night work as pleasant as day work. Have long life . . . low operating cost.

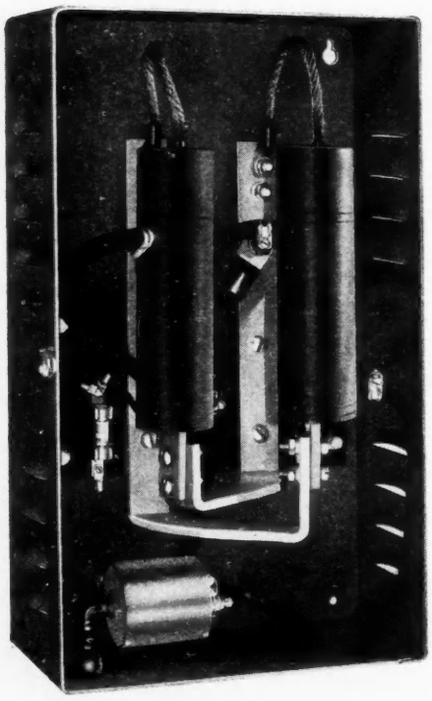
COOPER HEWITT mercury vapor lamps are long tube light sources free from shadow, and easy on eyes because they contain only cool yellow-green rays. Excellent for showing up small objects and detail.

GENERAL ELECTRIC

LAMP DEPARTMENT, NELA PARK, CLEVELAND, OHIO

SAVES

FOR USERS OF RESISTANCE WELDING



Are you interested in cutting your maintenance costs for resistance welding? Take a minute or two to tear out the coupon below, fill in your name and address and mail it to Westinghouse.

This will bring you the facts about Weld-o-trol ...the new type of control for resistance welders.

It is quiet . . . has no moving parts to wear out . . . prolongs electrode tip life . . . reduces outages . . . saves maintenance expense . . . and may be used with present timing equipment. Weld-o-trol will make and break the welding circuit 600 times a minute or more . . . and it will do this accurately and uniformly.

A minute or two to fill in the coupon will start the proof on the way to you. Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

J-20824

Westinghouse

SEND THE PROOF TO:

(Name)

(Company)

(Address)

(City and Town)

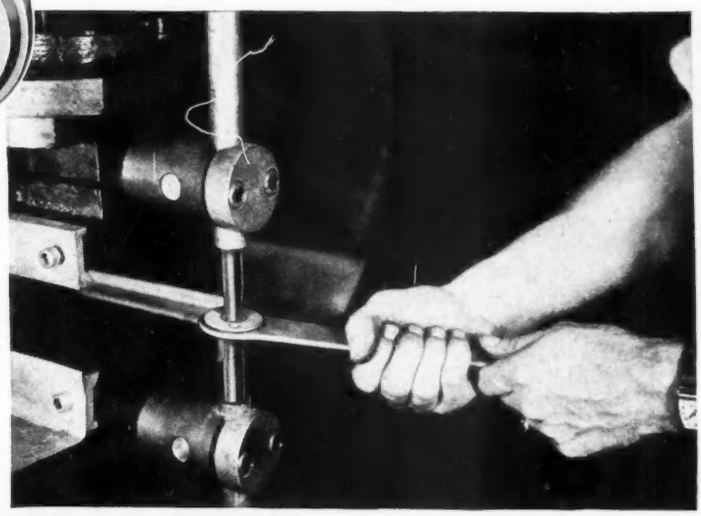
Weld-O-Trol

with the New **MALLORY TIP DRESSER**

Here's one of the greatest time savers ever developed for users of replaceable Spot Welding Tips. The Mallory Tip Dresser re-machines both upper and lower tips to their correct profile "on the job"... without necessitating removal of the tips from their water-cooled holders.

In addition to the "down" time it saves, the Mallory Tip Dresser insures the use of uniform contact area with the work. This means better and more uniform welds with greatly lowered dressing costs.

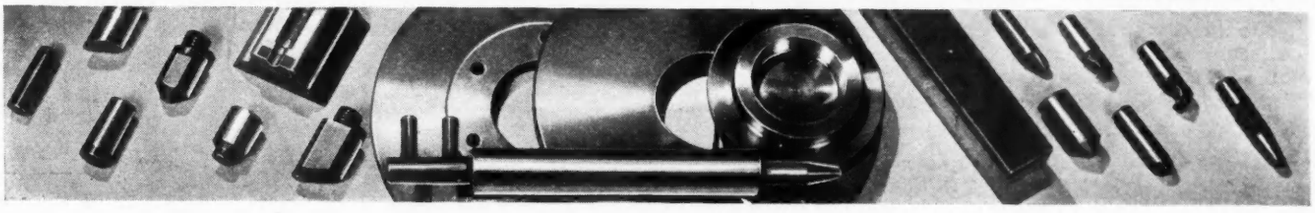
Mallory Tip Dressers have received an enthusiastic welcome everywhere in the welding industry. If you are not already taking advantage of this time and money saver . . . write for prices and complete details now. P. R. Mallory & Co., Inc., Indianapolis, Indiana. Cable Address—Pelmallo



P. R. MALLORY & CO. Inc.

MALLORY

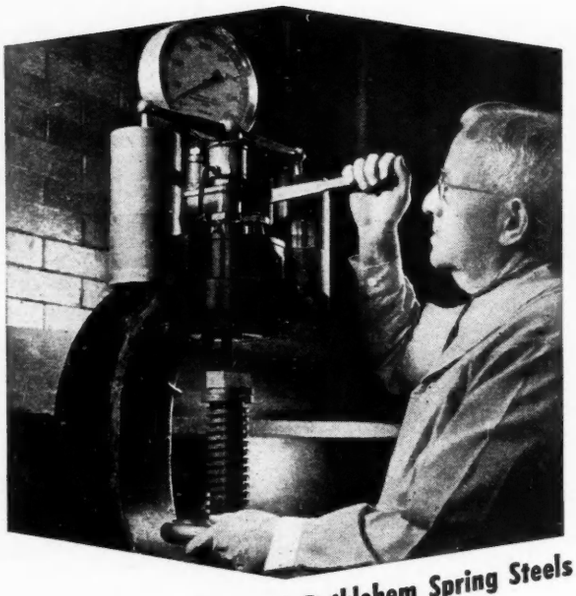
RESISTANCE WELDING ELECTRODES and HOLDERS



For ECONOMY

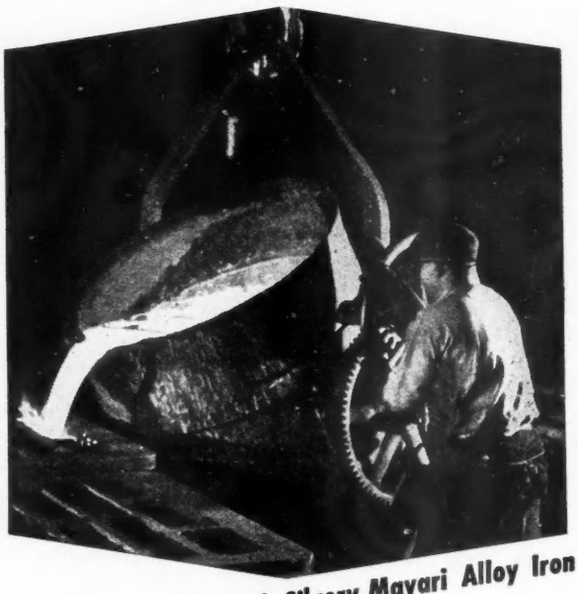
. . . specify Bethlehem Steels

In automotive manufacturing, the right materials can save you plenty—in longer tool and die life, in less scrap, in speedier, more continuous production. Bethlehem steels are consistently workable. They are available in a wide range of grades that give your designers ample scope for efficient, economical construction.



Economy and comfort with Bethlehem Spring Steels

Your customers will ride in luxurious comfort on properly designed springs made of Bethlehem Spring Steels. These steels are made for tough service on the road, are available in silico-manganese, carbon molybdenum, straight chrome and other grades, providing excellent resistance to fatigue or shock failure in service. And you'll find that Bethlehem Spring Steels offer real economies in your fabricating operations, too. They're uniform, respond readily to heat treatment, and thus insure a smooth continuity in the flow of work through the shop. Let a Bethlehem representative discuss your spring steel needs with you.



Economy in engines with Silvery Mayari Alloy Iron

Silvery Mayari, the natural silicon-nickel-chromium alloy iron, provides three major economies in casting engine blocks and other parts:

(1) More uniform hardness because of nickel and chromium content—better machining qualities, permits higher speeds and less waste on radial drilling and other operations.

(2) Versatility—with the same easy-flowing cupola mix you can cast both thick and thin sections, engine blocks, brake drums, rear axle differential gear cases, etc.

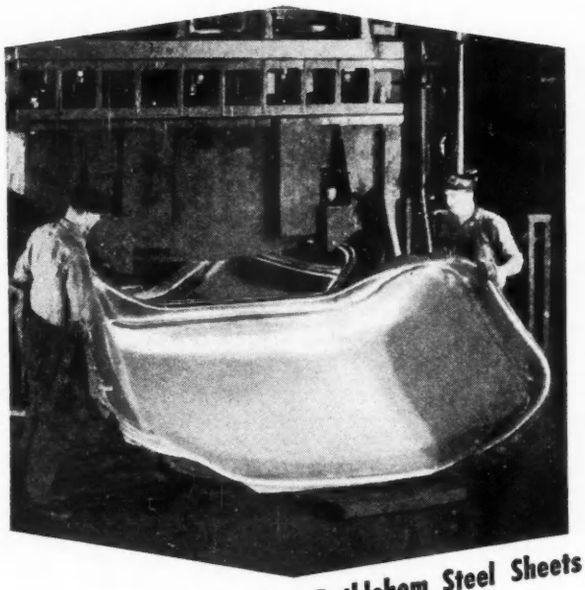
(3) Low cost—you can achieve all these savings in many cases by using as little as 5 per cent of Silvery Mayari in your cupola.

BETHLEHEM STEEL COMPANY, *General Offices:* Bethlehem, Pa. *District Offices:* Akron, Albany, Atlanta, Baltimore, Boston, Buffalo, Chicago, Cincinnati, Cleveland, Columbus, Dallas, Denver, Detroit, Honolulu, Houston, Indianapolis, Johnstown, Pa., Kansas City, Mo., Los Angeles, Milwaukee, Nashville, New Haven, New Orleans, New York, Philadelphia, Pittsburgh, Portland, Ore., St. Louis, St. Paul, Salt Lake City, San Antonio, San Francisco, Savannah, Seattle, Springfield, Mass., Syracuse, Toledo, Tulsa, Washington, Wilkes-Barre, York. *Export Distributor:* Bethlehem Steel Export Corporation, New York.

BETHLEHEM STEEL

Economy in forgings with Bethlehem Carbon Steel Bars

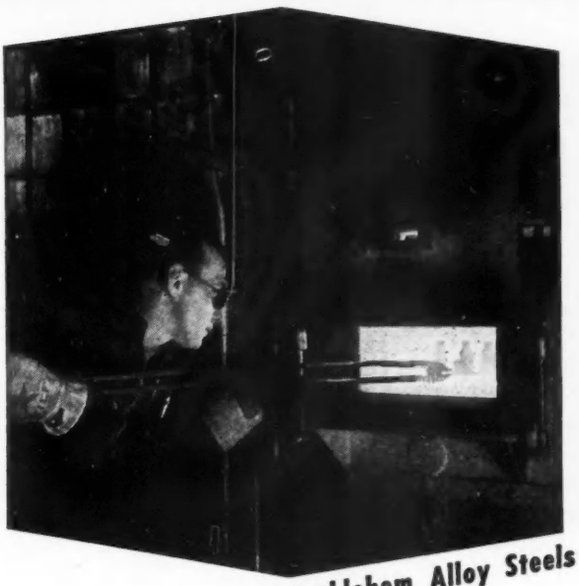
When you're manufacturing crankshafts, connecting rods and other forgings in mass production, you'll find it pays to standardize on uniform Bethlehem Carbon Steel Bars. These bars give a consistently satisfactory performance in forging, heat treating and machining operations. As a result, you have fewer rejects and more efficient parts production. Another saving you can easily achieve is the economy in specifying Bethlehem special sections—brake shoe tees, rim, bumper and many other sections.



Cut scrap losses by using Bethlehem Steel Sheets

Bethlehem Steel Sheets are so ductile that they draw in your big presses, can be formed into one-piece fenders, steel roofs, hoods, side panels, or floor panels and yet are adapted to small parts like brackets, torque tubes and generator housings.

"Our drawing record with Bethlehem Cold-Rolled Sheets on roof panels has been the best to date," reports one manufacturer. Another says, "Over 7 per cent less scrap loss on instrument panels made of Bethlehem Steel Sheets."



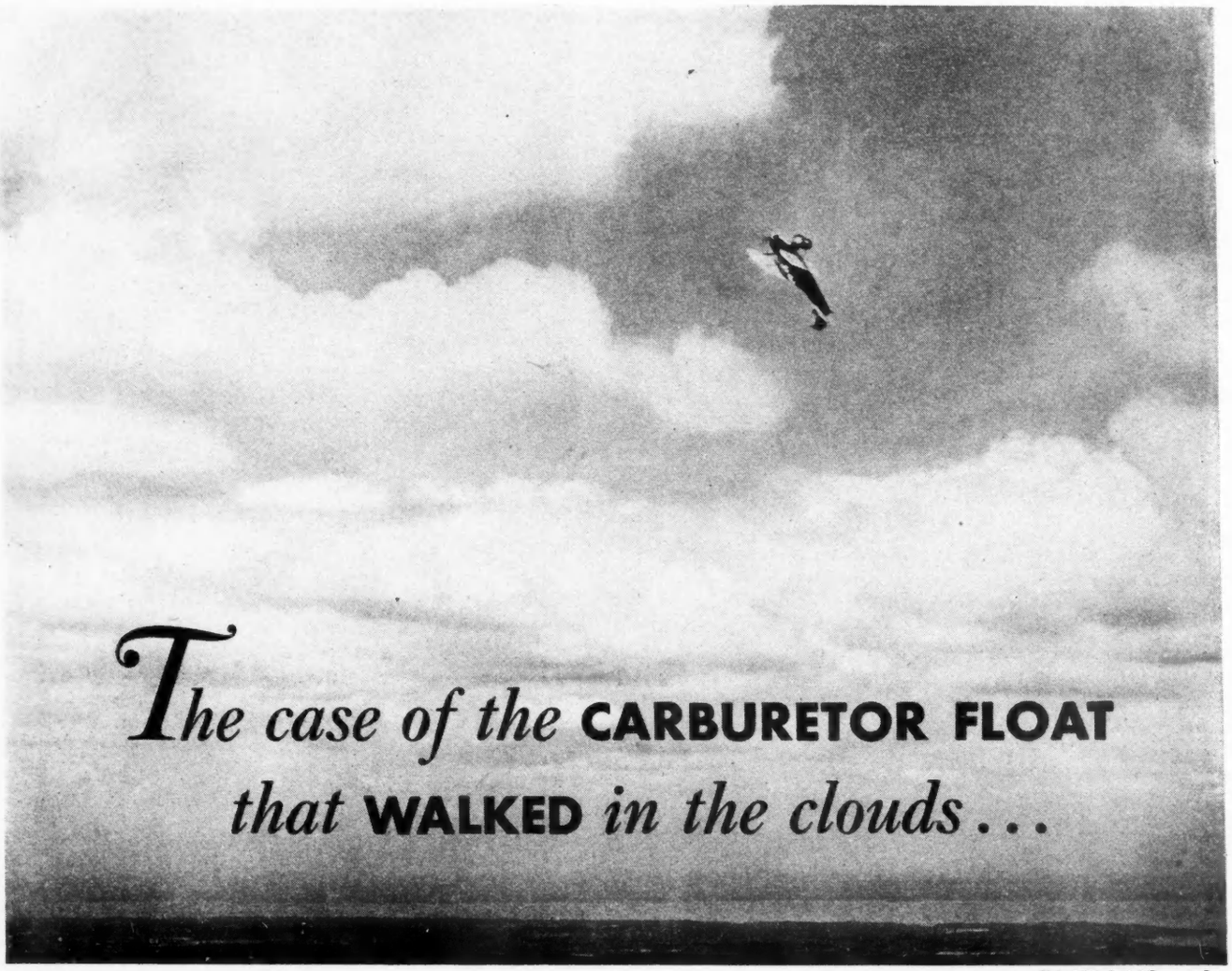
Savings in parts with Bethlehem Alloy Steels

For gears, universal joints, shafts, bearings, steering knuckles and arms, bolts, studs and other parts, Bethlehem Alloy Steels offer you the ultimate in performance in forging, heat treatment and machining operations. We can supply you with alloy steels that have the properties you want for any specific part, and these Bethlehem Alloy Steels are uniformly high in quality from shipment to shipment. There are several hundred Bethlehem Alloy Steels available for your selection.

Bethlehem Products for the Automotive Industry

Bars, alloy and carbon steel, including special sections: brake shoe tees, rim sections and bumper sections . . . sheets, hot-rolled and cold-rolled . . . wire . . . Mayari R weight-saving steel . . . shapes . . . plates . . . bolts, nuts, rivets . . . wire rope and strand . . . crane wheels . . . Silvery Mayari alloy iron . . . tool steel . . . pipe . . . forgings and castings . . . structural steels.

BETHLEHEM STEEL COMPANY



The case of the CARBURETOR FLOAT *that* WALKED *in the clouds . . .*

Fairchild Aerial Surveys, Inc.

AUTOMOTIVE ENGINEERS! . . . NOTE HOW NEOPRENE DOES THIS JOB WHERE OTHER MATERIALS FAIL

THIS pilot wasn't exactly nervous. But every time he slow-rolled his ship, the engine would start cutting out. Ten seconds on her back and the engine was dead.

His trouble was simple enough. On any ship the carburetor float valve would "walk away" from its seat in violent stunting.

He knew this "cutting out" was eliminated only by an elaborate two-carburetor system. But he wanted something better.

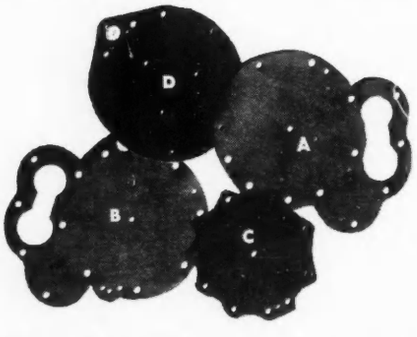
So a Holley engineer designed for him a carburetor *independent of gravity*. It was a new diaphragm assembly . . . with no floats to "walk away." Variable venturi replaced conventional fixed venturi.

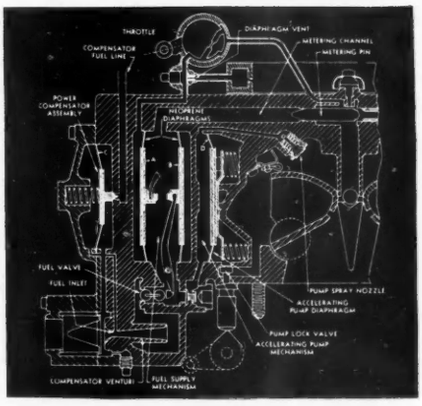
It was a sweet little job . . . but it still had a bug. Where was a strong, flexible diaphragm material resistant to gasoline? Every material failed to meet such exacting requirements . . . until he tried neoprene-impregnated fabric.

Then tests showed the diaphragms were right. He had it . . . the audacious Holley Carburetor, made possible by neoprene's unique resistance to gasoline.

The carburetor is now widely used. The neoprene diaphragms are *delivering* . . . in day in, day out contact with gasoline.

Neoprene is Du Pont's remarkable chemical rubber. It has the strength, resilience and toughness of natural rubber—but far more resistance to oils, gasoline, heat, ozone, aging and corrosive acids or gases.





Send for the monthly "Neoprene Notebook." It's packed with information to help you find new, profitable uses for neoprene. Write to E. I. du Pont de Nemours & Co. (Inc.), Rubber Chemicals Division, Wilmington, Delaware.

DU PONT
NEOPRENE
Chemical Rubber

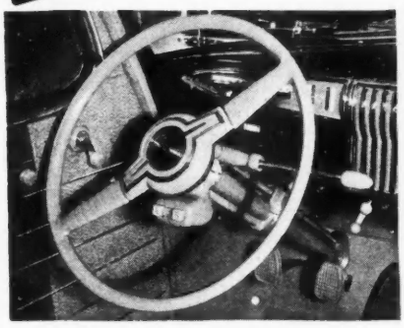
F.O.B. DETROIT

DO DIE CASTINGS INFLUENCE CAR SALES?

— A "Quiz"

F.O.B. DETROIT

Q Is the directional signal an important sales feature?



A Car buyers are always interested in safety features. The directional signal switch shown here (flashes a warning both fore and aft that a turn is to be made) is composed of five ZINC Alloy Die Castings. Three other cars have die castings performing similar duties.

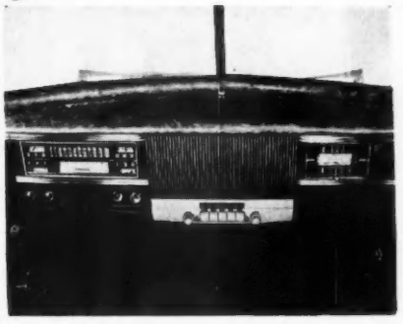
F.O.B. DETROIT

Q Is the public conscious of automotive "tailoring"?

A Automotive styling today is based on consumer demands—and ZINC Alloy Die Castings make many style trends possible. To make the headlamp bezel fit the fender, instead of vice versa, most 1940 fender lines require die cast bezels.

F.O.B. DETROIT

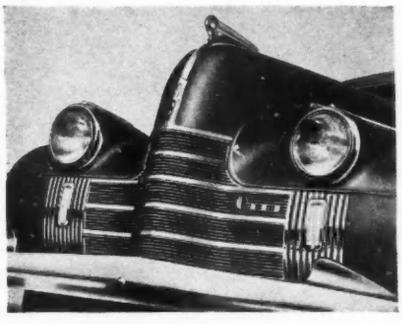
Q Do car dealers use the instrument panel as a sales point?



A When the dealer has a panel like the one shown above to point to, he is equipped with additional sales ammunition. This entire panel, with the exception of the instruments, clock and radio control, consists of four ZINC Alloy Die Castings.

F.O.B. DETROIT

Q How does the car buying public distinguish one make of car from another?



A The quickest way to differentiate between 1940 cars is to look at the front ends—at the radiator grilles. The car shown here employs a ZINC Alloy Die Cast grille for the sixth successive year. Only five makes of 1940 cars do not carry radiator grilles produced by this metal and method.

Appearance and selling price are two major factors in merchandising all products. ZINC Alloy Die Castings strongly influence both of these factors in a wide variety of items—from automobiles to floor lamps. If you are not thoroughly acquainted with the reasons why, we suggest that you consult a commercial die caster—or write to The New Jersey Zinc Company, 160 Front Street, New York City, New York.

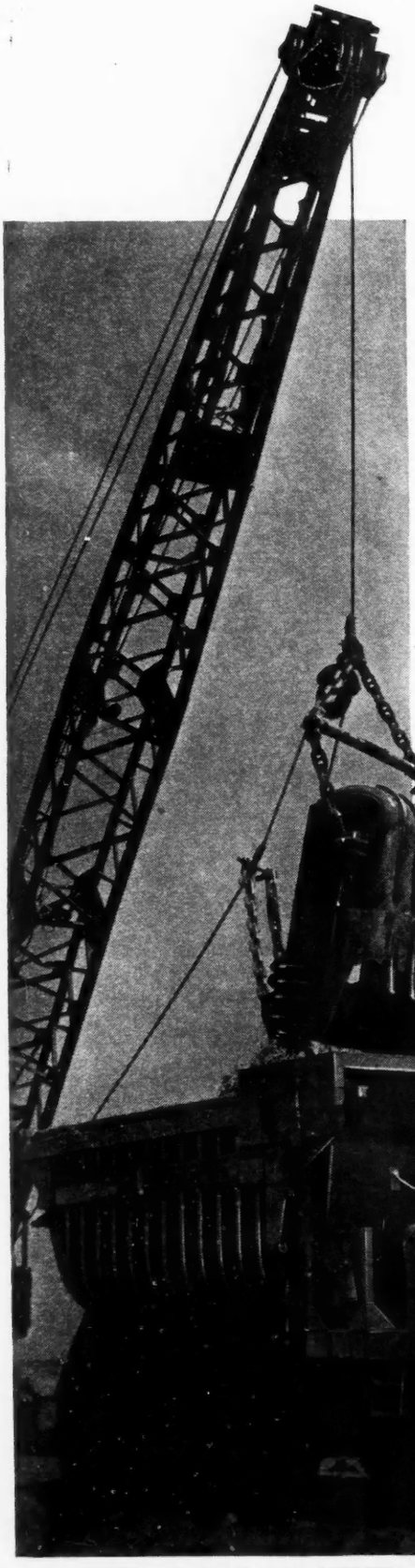
ZINC ALLOY DIE CASTINGS

The Research was done, the Alloys were developed, and most Die Castings are made with

HORSE HEAD SPECIAL (99.99+% Uniform Quality) ZINC

WHAT A TRUCK!

Hauls 76 tons in one load . . .
Made of U·S·S Steels throughout



WITH capacity of 42 cu. yds., this mammoth earth moving unit — the largest successful truck of its kind ever developed — has easily handled test loads of 45 cu. yds. of wet sand silt, both uphill and down without sign of distress.

To fully meet the extraordinary demands of strength and stamina involved in this amazing construction, the Trojan Truck Company of Los Angeles used U·S·S Steels throughout.

Body was made of U·S·S 4″ H-Beams and U·S·S Tank Plate, the bottom lined with U·S·S Abrasion Resisting Steel. Front and rear axles made from SAE-4140. Steering knuckles forged from SAE X-3140. Throughout the 12-speed transmission and differential gears, pinions, jack shafts and counter shafts, other well-known U·S·S Carilloy Steels were used — SAE-3140, SAE-4615, SAE-2315 and SAE-2345. Locally forged, machined, carburized and heat treated under our recommendations.

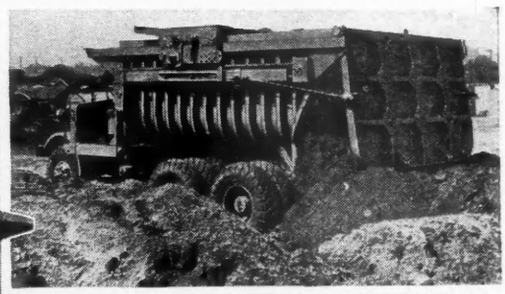
To pay for itself a truck of this size must be able to meet exacting standards of performance, day after day. Unfailing dependability is a prime requisite—and U·S·S Steels assure it.

Here are superior steels, to resist abrasion, corrosion, heat, wear — steels to last longer in every kind of industrial application. We'd like to show you how to apply them most economically to your needs.

CARNEGIE-ILLINOIS STEEL CORPORATION

Pittsburgh and Chicago

Columbia Steel Company, San Francisco, *Pacific Coast Distributors*
United States Steel Products Company, New York, *Export Distributors*



This 14-wheel road giant, powered by a mammoth 8 cylinder Diesel engine developing 190 H.P. at 1150 r.p.m., operates at a total fuel cost of only 20 cents an hour. Has 9 speeds forward and 3 in reverse. Will attain a speed of 25 miles an hour along a level road.

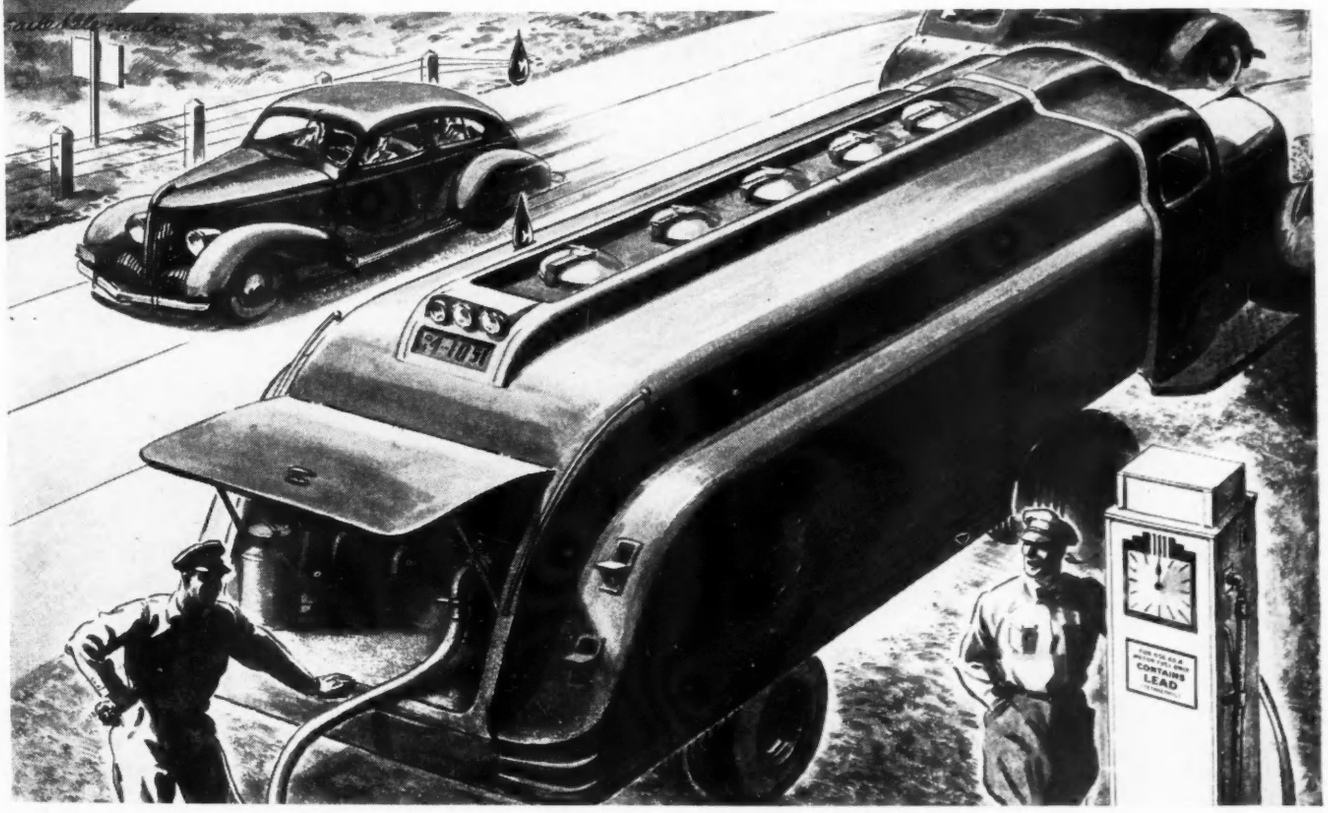
A power-driven traveling bulkhead dumps the load, will spread dirt 4 inches to 3 feet deep and from 11 to 13 feet wide. Clutch and brakes are operated by compressed air. Hydraulic mechanism makes steering as easy as on a late model light automobile.

USS

UNITED STATES STEEL

IMPROVING 15 BILLION GALLONS OF GASOLINE A YEAR

. . . tetraethyl lead!



THE automobile, airplane, tractor, bus and truck engines of America not only have a tremendous appetite... but they are fussy in their tastes, too. They will deliver only the performance that the anti-knock quality of the gasoline you feed them permits.

That's why tetraethyl lead is, today, almost as important as gasoline itself. Just a small quantity of this powerful, volatile liquid added to a gallon of gasoline improves its anti-knock value. It acts to prevent the annoying, power-wasting "knock" or "ping" that years ago threatened the development of the modern high-compression engine.

As the active ingredient of the anti-knock fluids made by the Ethyl Gasoline Corporation, tetraethyl lead is now used by oil companies in the United States and Canada to improve more than 15 billion gallons of gasoline a year . . . over 70% of all motor fuel sold in these two countries. It is this "leaded" gasoline that is helping modern high-compression engines give more power with less weight, run farther and faster on less fuel.

At the right you see what tetraethyl lead means in the performance of any gasoline engine:

TODAY EVERY CAR HAS 3 GRADES OF PERFORMANCE

Because there are different grades of gasoline sold today, any engine has different grades of performance, depending on the gas and the spark setting. Use the chart below to help you make your choice:

BEST PERFORMANCE—with gasoline marked "Ethyl" on the pump or globe. It is highest in anti-knock and all-around quality. Contains enough tetraethyl lead so that the engine's spark can be *advanced* closest to the point of maximum power and economy without "knock" or "ping."

GOOD PERFORMANCE—with "regular" gasoline, which permits the spark to be considerably advanced without "knock" or "ping." Most "regular" gasolines now contain tetraethyl lead, as shown by the "Lead" signs on the pumps.

POOR PERFORMANCE—with low-grade gasoline, poor in anti-knock quality. With low-grade gasoline, the engine's spark must be *retarded*—which means *loss* of power.

THIS MONDAY NIGHT TUNE IN ON "TUNE-UP TIME" featuring Tony Martin, Andre Kostelanetz' Orchestra . . . Kay Thompson and Rhythm Singers . . . Columbia Broadcasting System, 8 p. m., E. S. T.

ETHYL GASOLINE CORPORATION, ***manufacturer of anti-knock fluids used by oil companies to improve gasoline***

Photograph by H. Armstrong Roberts

AUTOMOTIVE INDUSTRIES

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PRIVATE

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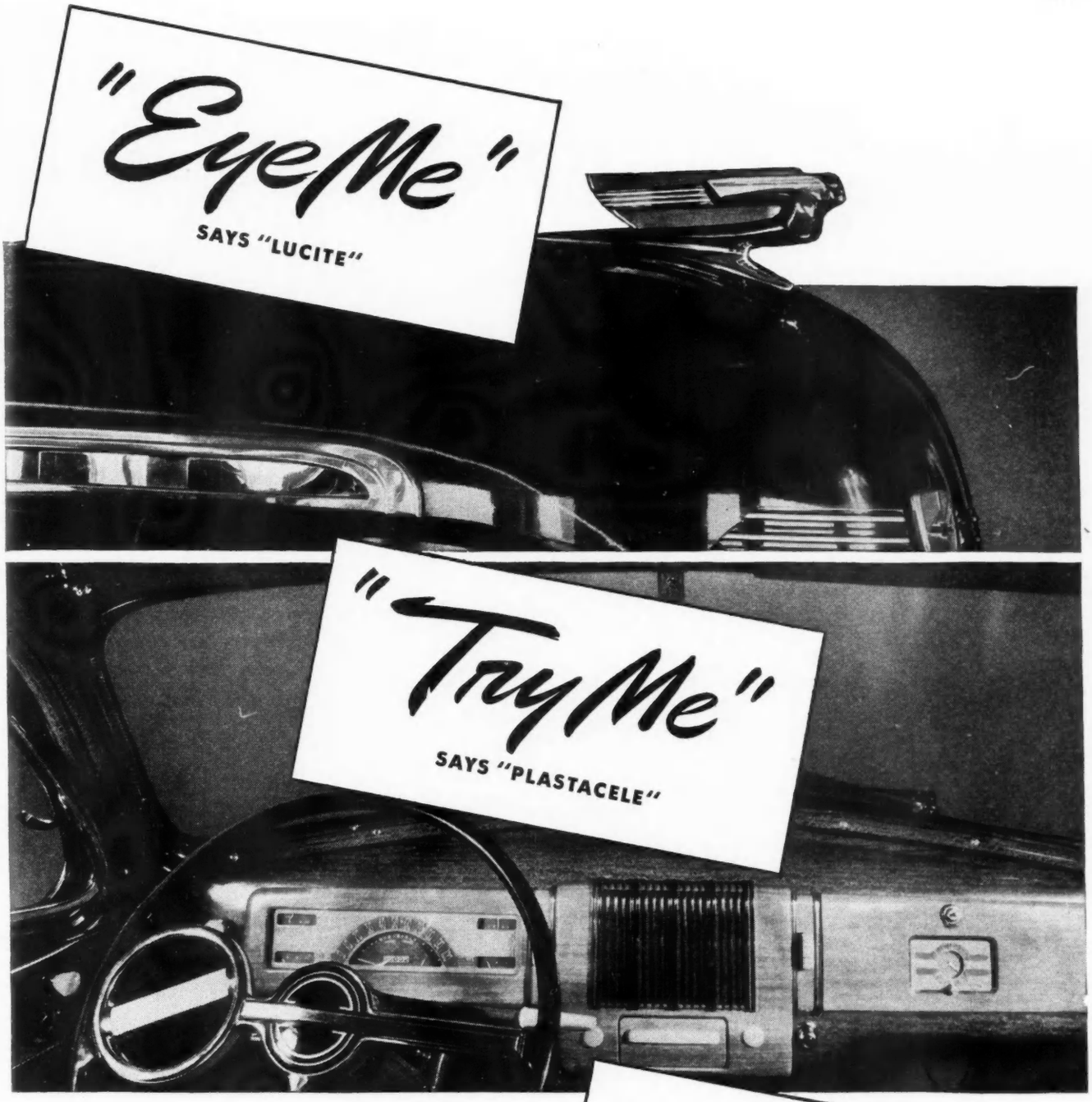

"Buy Me"
SAYS CHEVROLET
with

DU PONT
REG. U. S. PAT. OFF.
PLASTICS

AND Chevrolet proclaim more individual design changes this year than they have made since '28. Note this, however: Du Pont Plastics play a major part as the materials with which they design—*more this year than ever before.*

Winging its way out front, as it did so effectively last year, is the radiator ornament . . . molded of "Lucite" methyl methacrylate resin. Its crystal clarity and lustre are weather resistant.

Inviting you for a spin are the steering wheel and interior hardware . . . molded from "Plastacele" cellulose acetate. The beauty and versatility of this plastic are economically achieved.

For modern, functional applications you can depend on Du Pont Plastics. With the tougher problems, come right to us for design suggestions. Du Pont, Plastics Department, Arlington, N. J.

Here's a PROFITABLE ANSWER *to More and More Fabricating Problems*

EXAMINE YOUR own products. Perhaps there are several places where you can improve them at worthwhile savings by fabricating them from American Quality Cold Rolled Strip Steel.

AMERICAN Quality Cold Rolled Strip Steel is getting the call wherever the requirements demand a metal that offers attractive finish, uniformity, ductility and LOW COST. Investigation will prove to you that this product can be relied upon to make serviceable, dependable parts that are light in weight, have a smooth, shining finish, and are completely accurate in size.

The complete range of widths, finishes, edges and tempers available in American Quality Cold Rolled Strip Steel provides unlimited possibilities for the improvement of numerous items at reduced costs. This product is easily adapted to high speed continuous operations and is doing an outstanding job in many places where more expensive metals were formerly used.

Our facilities for producing American Quality Cold Rolled Strip Steel have been expanded to meet the increasing demands of industry for this product in its many forms. We have assisted many manufacturers in planning the most economical application of Cold Rolled Strip Steel in their operations and our representatives gladly offer this service to you.

AMERICAN *Quality* COLD ROLLED STRIP STEEL

AMERICAN STEEL & WIRE COMPANY

Cleveland, Chicago and New York

Columbia Steel Company, San Francisco, *Pacific Coast Distributors* · United States Steel Products Company, New York, *Export Distributors*

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☛ ***This Book Includes***

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This book will save a great deal of your time, enable you to keep your tax down, and avoid the trouble of later assessments. We offer it on this double guarantee: 1. Look through it. If you do not agree it will be of definite help — return it, your money will be refunded. 2. OR—*after* you have made out your return with this book's help, if it has not actually saved you time and money, return it then, we will refund its full price to you.

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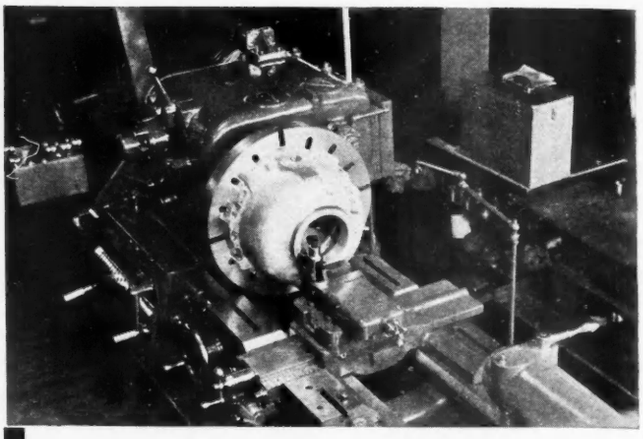
ACKERMAN BLAESSER—FEZZEY, INC.
1306 HOLDEN AVENUE DETROIT, MICHIGAN



Big Machining Jobs!

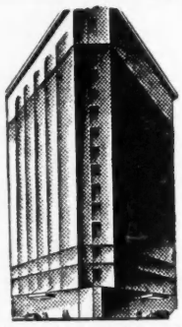
With equipment such as the 30" tool-room lathe above illustrated, for machining parts for the new giant 2000 H.P. airplane engines, few automotive or aircraft machining jobs are too big or too delicate for Govro-Nelson.

This is why leading makers of automotive and aircraft engine parts entrust to us such a large part of their precision machine work.

● *Write Us Concerning Your Requirements!*

THE GOVRO-NELSON COMPANY

1931 Antoinette Detroit, Mich.



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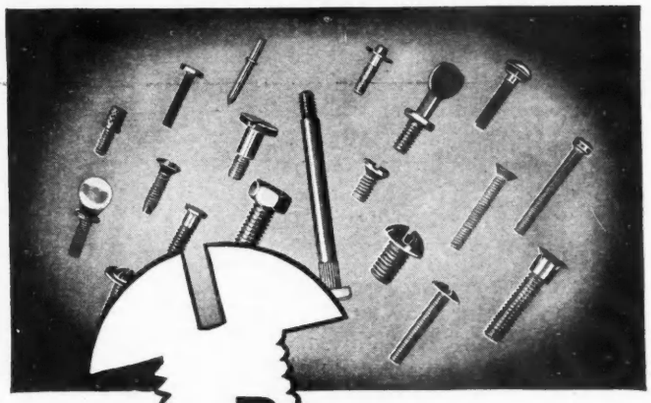
Rates from $2.50 Single

HOTEL
LINCOLN



PROTECT your product — and reduce costs — at every point where fastening devices are required by using screws and headed parts by PROGRESSIVE. Let PROGRESSIVE items, produced efficiently and accurately by the cold upset process, show you the way to substantial savings both in original costs and in assembly operations. In addition to standard machine screws and nuts, PROGRESSIVE is equipped to meet demands for made-to-order parts in any metal. We invite you to submit your problems to PROGRESSIVE specialists for intelligent, prompt solution.

QUALITY PROMCO BRAND

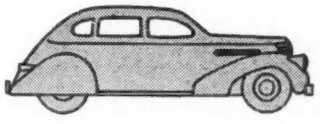
The PROGRESSIVE MFG. CO.
TORRINGTON · · · CONNECTICUT

By using flexible shaft remote controlled radio you can take the radio receiver out of the front compartment entirely.

The space you gain will help to relieve front compartment congestion and make it easier to work out locations for emergency brake handle, cowl vent handle, windshield wiper mechanism, defroster tubing, heater and air conditioning units.

Remember that *flexible shaft remote controlled radio is tried and proved.* Furthermore it can be applied without requiring any changes in your present panel design.

Flexible shaft remote controls have been successfully used on practically every make of auto radio, which means that the development work has all been done, and your radio manufacturer can supply remote controlled radios without delay. Consult him.



WRITE FOR ENGINEERING BULLETINS

They will give you up-to-date information and data about S. S. White flexible shafts specially developed for auto radio and other remote control uses—also about S. S. White shafts for power drives. Write for them—today.

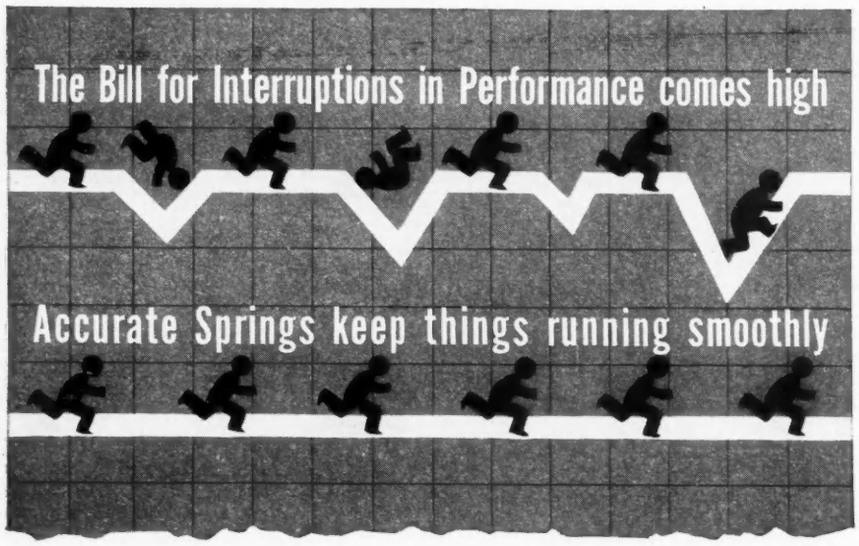
S. S. WHITE

The S. S. White Dental Mfg. Co.

INDUSTRIAL DIVISION

Department A, 10 East 40th St., New York, N. Y.

• FLEXIBLE SHAFTS for POWER DRIVES and REMOTE CONTROLS •



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SMALL STAMPINGS
WIRE FORMS

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BARNES-GIBSON-RAYMOND
DETROIT PLANT DETROIT, MICHIGAN — DIVISION OF ASSOCIATED SPRING CORP. — TWO PLANTS — COOK PLANT ANN ARBOR, MICHIGAN

Two Four-Star Features

PRODUCTION METHODS are described in the first issue of each month:

AUTOMOTIVE MATERIALS are discussed in the second issue of each month

in

AUTOMOTIVE INDUSTRIES

The semi-monthly magazine of automotive industrial manufacturing establishments

BUYERS' GUIDE

Automotive Products and Factory Equipment Manufactured by Advertisers in This Issue

See Alphabetical List of Advertisers on page 78

This Buyers' Guide is published as a convenience, and not as part of the advertising contract. Every care will be taken to index correctly. No allowance will be made for errors or failure to insert.

Acid, Sulphuric
New Jersey Zinc Co.

Air Valves, Punch Press
F. J. Littell Machine Co.

Alloy Steels, Cold Finished
Bliss & Laughlin, Inc.

Alloys
Bethlehem Steel Co.
Carnegie-Illinois Steel Corp., U. S. Steel Corp. Subsidiary
Ferro
New Jersey Zinc Co.
Non-Ferrous
Aluminum Co. of America
P. R. Mallory & Co., Inc.
New Jersey Zinc Co.

Arms & Knuckles, Steering
Atlas Drop Forge Co.

Auto Body Panels
Motors Metal Mfg. Co.

Axles
Atlas Drop Forge Co.
National Tube Co., Subsidiary of U. S. Steel Corp.
Union Drawn Steel Co. (Cold Drawn)

Bars
Cold Drawn
Bliss & Laughlin, Inc.

Bearings
Ball
Bantam Bearings Corp. (Radial & Thrust)
Federal Bearings Co., Inc.
Clutch Release
Bantam Bearings Corp.
Quill Roller
Bantam Bearings Corp.
Roller
Bantam Bearings Corp. (Tapered)
Hyatt Bearings Division General Motors Corp.
Timken Roller Bearing Co. (Tapered)

Belting, Metal Conveyor, High & Low Temperature
Wickwire Spencer Steel Co.

Blanks
Forged
Atlas Drop Forge Co.
Bethlehem Steel Co.
Wyman-Gordon Co.

Bolts
Rockford Screw Products Co.

Bolts & Nuts
National Acme Co.

Boring Machines
Bullard Co.
Heald Machine Co.

Brake Strand
Wickwire Spencer Steel Co.

Camshafts
Atlas Drop Forge Co.

Castings
Aluminum
Aluminum Co. of America
Steel
Bethlehem Steel Co.
Carnegie-Illinois Steel Corp., U. S. Steel Corp. Subsidiary

Channels for Glass
Felt
American Felt Co.

Chucks
Collet
National Acme Co.
Magnetic
Heald Machine Co.

Clamps, Hose (Adjustable)
Wittek Mfg. Co.

Clutches
Borg & Beck Div. Borg-Warner Corp.
Twin Disc Clutch Co.

BUYERS' GUIDE—Continued

Connecting Rods
Aluminum Co. of America
Atlas Drop Forge Co.
Wyman-Gordon Co.

Contact Points, Electrical
P. R. Mallory Co., Inc.

Cowls
Motors Metal Mfg. Co.

Cranes, Traveling
Harnischfeger Corp.

Crankshafts
Atlas Drop Forge Co.
Union Drawn Steel Co.
Wyman-Gordon Co.

Cutters, Milling
Barber-Colman Co.

Cylinder Heads
Aluminum Co. of America

Die Heads
National Acme Co.

Die Making Machines
Wittek Mfg. Co.

Die Sets
Danly Machine Specialties, Inc.

Discs, Clutch
Borg & Beck Div. Borg-Warner Corp.

Drilling Machines
National Acme Co.

Drop Forgings
Aluminum Co. of America
Atlas Drop Forge Co.
Wyman-Gordon Co.

Dust Shields
Motors Metal Mfg. Co.

Engines
Govro-Nelson Co. (Aircraft)
Waukesha Motor Co.

Feeds, Roll for Punch Press
F. J. Littell Machine Co.
Wittek Mfg. Co.

Felt
American Felt Co.

Fenders
Motors Metal Mfg. Co.

Filing Machines
Wittek Mfg. Co.

Forgings
Bethlehem Steel Co.
Carnegie-Illinois Steel Corp., U. S. Steel Corp. Subsidiary
Wyman-Gordon Co.

Furnaces, Electric
American Bridge Co., U. S. Steel Corp. Subsidiary
Westinghouse Electric & Mfg. Co. (Annealing, Carburizing, Heat Treating, Forging and Welding)

Gages
Electric (Fuel Lever)
King-Seeley Corp.
Gasoline, Auto
King-Seeley Corp.
Oil Pressure
King-Seeley Corp.
Water Pressure
King-Seeley Corp.

Gaskets, Felt
American Felt Co.

Gasoline
Ethyl Gasoline Corp.

Gear Boxes
Cotta Transmission Corp.

Gear Material (Non-Metallic)
Westinghouse Elec. & Mfg. Co.

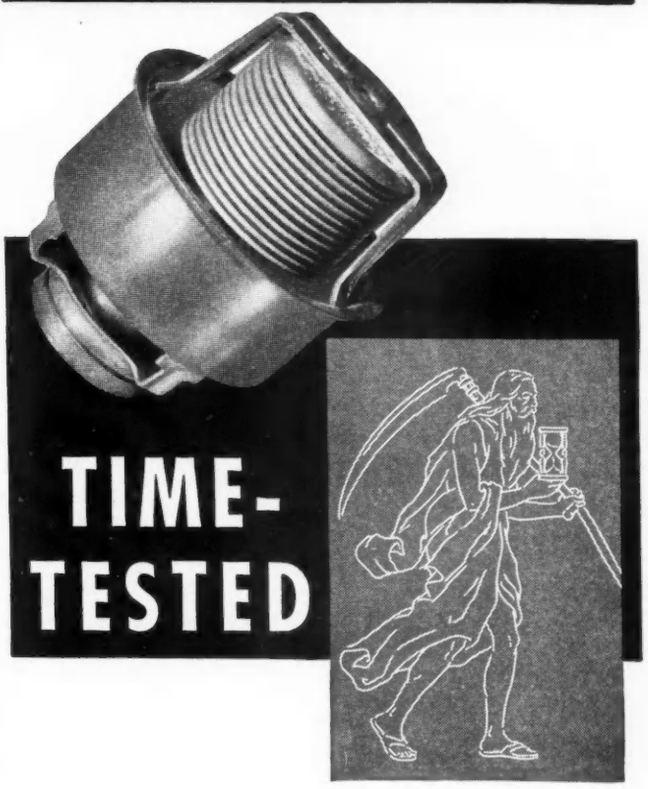
Gears, Reduction
Cotta Transmission Corp.

Gears, Timing
Non-Metallic
Westinghouse Electric & Mfg. Co.

Grinding Machines
Internal
Heald Machine Co.
Plain Tool
National Acme Co.
Surface
Heald Machine Co.

(*Turn to page 74, please*)

Sylphon TRADE MARK
THE Standard THERMOSTAT



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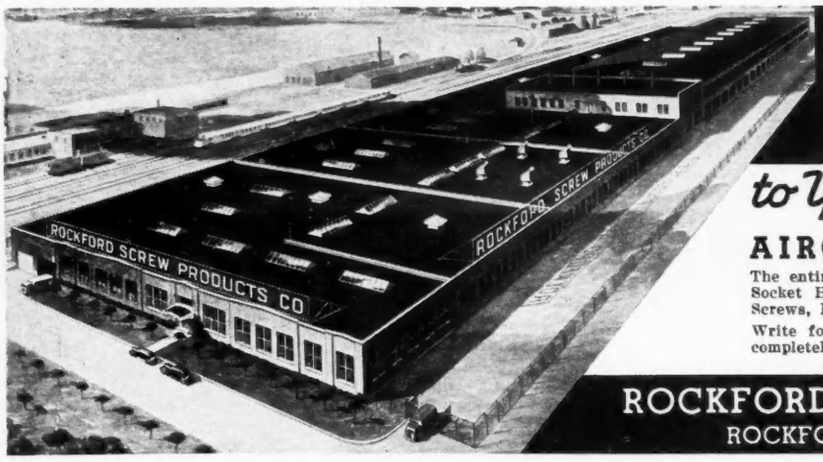
Developed through years of research, in close cooperation with automotive engineers, the Sylphon Thermostat has become a vital factor in the improvement in performance of today's highly efficient motor car engines.

Use Sylphon Thermostats!

THE FULTON SYLPHON COMPANY
KNOXVILLE, TENN.



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to Your Specifications
AIRCRAFT and AUTOMOTIVE
The entire facilities of our modern plant are at your disposal for Socket Head Cap and Set Screws, Cap, Set, Wood and Machine Screws, Extruded Bolts, Gulmite Screws, Dardelet Rivet Bolts, etc.
Write for our aircraft or general catalog to determine just how completely we can serve your production needs.
ROCKFORD SCREW PRODUCTS CO.
ROCKFORD ILLINOIS

BUYERS' GUIDE— (*Continued from page 73*)

Heat Treating
Barnes Co., Wallace, Div. of Associated Spring Corp.
Barnes - Gibson - Raymond, Div. of Associated Spring Corp.
Gibson Co., Wm. D., Div. of Associated Spring Corp.

Hinges, Automobile Door (Concealed)
Ackerman-Blaesser & Fezzy, Inc.

Hob Sharpening Machines
Barber-Colman Co.

Hobbing Machines
Barber-Colman Co.

Hobs, Gear
Barber-Colman Co.

Hoists, Electric
Harnischfeger Corp.

Hoods
Motors Metal Mfg. Co.

Hotels
Hotel Lincoln (Indianapolis)
Hotel Radisson (Minneapolis)
Hotel Wisconsin (Milwaukee)

Inserted Tooth Reamers
Barber-Colman Co.

Lamps, Industrial
General Electric Vapor Lamp Co.

Lathes
Automatic & Semi-Automatic
National Acme Co.

Automatic Chucking
Bullard Co.
Potter & Johnston Machine Co.

Chucking
National Acme Co.

Multiple Spindle
Bullard Co.

Turret
Bullard Co.
National Acme Co.
Potter & Johnston Machine Co.

Leaded Steels
Bliss & Laughlin, Inc. (Cold Finished)
Inland Steel Co.

Machine, Straightening for Punch Presses
F. J. Littell Machine Co.

Machine Work (Special Contract)
Govro-Nelson Co.

Milling Machines
Potter & Johnston Machine Co.

Molding Materials (Power)
E. I. duPont de Nemours & Co., Inc. (Plastics Dept.)

Motor Pans
Motors Metal Mfg. Co.

Motors, Electric Power
Westinghouse Electric & Mfg. Co.

Oil Seals
American Felt Co. (Gyro-Stat)

Oils
Break In
Acheson Colloids Corp.

Cutting
Cities Service Oil Co.

Lubricating
Acheson Colloids Corp.

Pads, Felt
American Felt Co.

Paints, Aluminum
Aluminum Co. of America

Parts
Aircraft Engine
Govro-Nelson Co.

Automotive Precision
Govro-Nelson Co.

Perforated Metal
Wickwire Spencer Steel Co.

Pistons
Aluminum Co. of America

Plastic Materials, Sheets, Rods & Tubes
E. I. du Pont de Nemours & Co., Inc. (Plastics Dept.)

Power Unit Drives
Cotta Transmission Corp.

Powerplants, Industrial (Portable)
Waukesha Motor Co.

Punch Press Feeds
F. J. Littell Machine Co.

Radiator Shells
Motors Metal Mfg. Co.

Radiator Shields
Motors Metal Mfg. Co.

Radio, Remote Control
S. S. White Dental Mfg. Co.

Reamer, Sharpening Machines
Barber-Colman Co.

Reels, Automatic Centering (Coil Stock)
F. J. Littell Machine Co.

Refrigerator Stampings
Motors Metal Mfg. Co.

Rivets
Bethlehem Steel Co.
Progressive Mfg. Co.

Rubber Chemicals
E. I. duPont de Nemours & Co., Inc., Rubber Chemicals Division

BUYERS' GUIDE—Continued

Running Board Shields

Motors Metal Mfg. Co.

Running Boards, Metal

Motors Metal Mfg. Co.

Sawing Machines

Wittek Mfg. Co.

Screens, Woven Wire

Wickwire Spencer Steel Co.

Screw Machine Products

Barnes Co., Wallace, Div. of Associated Spring Corp.
National Acme Co.
Progressive Mfg. Co.

Screw Machines

National Acme Co.
Potter & Johnston Machine Co.

Screw Stock, Cold Drawn

Bliss & Laughlin, Inc.

Screws

Cap
Nationl Acme Co.
Rockford Screw Products Co.

Machine
National Acme Co.
Progressive Mfg. Co.
Rockford Screw Products Co.

Set
National Acme Co.
Rockford Screw Products Co.

Wood
Rockford Screw Products Co.

Shafting

Bliss & Laughlin, Inc.
Jones & Laughlin Steel Corp. (Turned & Polished, Turned & Ground, Cold Drawn)
National Tube Co., Subsidiary of U. S. Steel Corp. (Hollow)
Union Drawn Steel Co.

Shafting, Steel, Cold Drawn

Bliss & Laughlin, Inc.

Shafts, Axle, Propeller and Transmission

Mechanics Universal Joint (Division Borg-Warner Corp.)

Shafts & Casings, Flexible (Radio)

S. S. White Dental Mfg. Co.

Springs

Extension, Compression, Torsion or Flat
Barnes Co., Wallace, Div. of Associated Spring Corp.
Barnes - Gibson - Raymond, Div. of Associated Spring Corp.
Cook Plant of Barnes-Gibson - Raymond Div. of Associated Spring Corp.
Gibson Co., Wm. D., Div. of Associated Spring Corp.
Jones & Laughlin Steel Corp.
Raymond Mfg. Co., Div. of Associated Spring Corp.
Wickwire Spencer Steel Co.

Stampings or Drawings

Metal
Barnes Co., Wallace, Div. of Associated Spring Corp.
Barnes - Gibson - Raymond, Div. of Associated Spring Corp.
Cook Plant of Barnes-Gibson-Raymond, Div. of Associated Spring Corp.
Gibson Co., Wm. D., Div. of Associated Spring Corp.
Motors Metal Mfg. Co.
Raymond Mfg. Co., Div. of Associated Spring Corp.
Worcester Stamped Metal Co.

Stands, Reel (Coil Stock)

F. J. Littell Machine Co.
Wittek Mfg. Co.

(*Turn to page 76, please*)

PJ FOR OVER 40 YEARS PJ
THE PIONEER MANUFACTURER OF
AUTOMATIC CHUCKING EQUIPMENT
POTTER & JOHNSTON MACHINE CO.
PAWTUCKET, R. I., U. S. A.

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American Quality Felt Seals exclude dust and all extraneous matter. Send for Data Sheet No. 5.
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MECHANICS
MECHANICS UNIVERSAL JOINT DIVISION
Borg-Warner Corp., 2026 Harrison Ave., ROCKFORD, ILL.

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IT'S THE HOTEL WISCONSIN
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ROOMS from $1.50
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HOTEL WISCONSIN

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QUALITY SERVICE and HOSPITALITY

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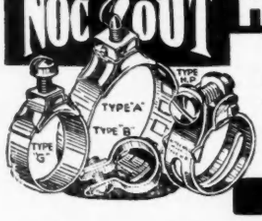
RICHARD KITCHEN, Gen. Mgr.

KNOCKOUT HOSE CLAMPS



"The HOSE CLAMP WITH THE THUMB SCREW"
Standard replacement clamp of the automotive industry—quick tightening—balanced two-side pull gives equal pressure all around, assures perfect seal. Type A for radiator hose—1 size equals many. GBB for booster brakes; GHH for heater hose. H-P for high pressure air and gas lines. Type B—Brass bonding clamp for windshield wiper hose.

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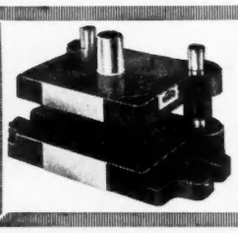
All shapes and sizes to 500 lbs.
ANY ALLOY STEEL · LABORATORY CONTROLLED
ATLAS DROP FORGE CO · LANSING, MICHIGAN



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DANLY ALL-STEEL SETS • DANLY COMMERCIAL SETS • DANLY DIE MAKERS' SUPPLIES
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DANLY MACHINE SPECIALTIES, Inc.
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RUNNING BOARD SHIELDS
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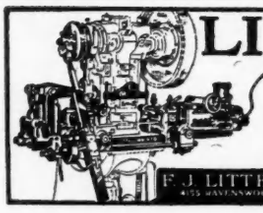
RADIATOR SHELLS
BODY STAMPINGS

MOTORS METAL MFG. CO.
5936 Milford Ave. Detroit, Mich.

LITTELL ROLL FEEDS
FOR FASTER SPEEDS



Modernize your presses! Increase production! Improve quality! *Ask for Bulletins.*
F. J. LITTELL & MACHINE CO.
4455 RAVENSWOOD AVE. CHICAGO, ILLINOIS

BUYERS' GUIDE—(*Continued from page 75*)

Steel

Alloys
Bethlehem Steel Corp.
Bliss & Laughlin, Inc.
Carnegie - Illinois Steel Corp., U. S. Steel Corp. Subsidiary
Republic Steel Corp.
Union Drawn Steel Co.
Vanadium Alloys Steel Co.

Bars
Bethlehem Steel Co.
Bliss & Laughlin, Inc.
Carnegie - Illinois Steel Corp., U. S. Steel Corp. Subsidiary
Columbia Steel Co., U. S. Steel Corp. Subsidiary
Inland Steel Co.
Jones & Laughlin Steel Corp.
Republic Steel Corp.
Tennessee Coal, Iron & Railroad Co., U. S. Steel Corp. Subsidiary
Union Drawn Steel Co.

Billets
Bethlehem Steel Co.
Carnegie - Illinois Steel Corp., U. S. Steel Corp. Subsidiary
Columbia Steel Co., U. S. Steel Corp. Subsidiary
Jones & Laughlin Steel Corp.
Tennessee Coal, Iron & Railroad Co., U. S. Steel Corp. Subsidiary

Carbon
Bethlehem Steel Co.
Bliss & Laughlin, Inc.
Carnegie - Illinois Steel Corp., U. S. Steel Corp. Subsidiary
Columbia Steel Co., U. S. Steel Corp. Subsidiary
Jones & Laughlin Steel Corp.
Republic Steel Corp.
Tennessee Coal, Iron & Railroad Co., U. S. Steel Corp. Subsidiary
Union Drawn Steel Co.

Cold Drawn
American Steel & Wire Co., U. S. Steel Corp. Subsidiary
Bliss & Laughlin, Inc.
Jones & Laughlin Steel Corp.
Republic Steel Corp.
Union Drawn Steel Co.
Vanadium-Alloys Steel Co.

Cold Drawn Flats
Bliss & Laughlin, Inc.

Die
Vanadium-Alloys Steel Co.

Electric Furnace
Bethlehem Steel Co.
Bliss & Laughlin, Inc.
Carnegie - Illinois Steel Corp., U. S. Steel Corp. Subsidiary
Union Drawn Steel Co.
Vanadium-Alloys Steel Co.

High Speed
Vanadium-Alloys Steel Co.

Plates
Inland Steel Co.

Rails
Inland Steel Co.

Shapes
Bethlehem Steel Co.
Carnegie - Illinois Steel Corp., U. S. Steel Corp. Subsidiary
Columbia Steel Co., U. S. Steel Corp. Subsidiary
Jones & Laughlin Steel Corp.
Tennessee Coal, Iron & Railroad Co., U. S. Steel Corp. Subsidiary

Sheets
Bethlehem Steel Co.
Carnegie - Illinois Steel Corp., U. S. Steel Corp. Subsidiary
Columbia Steel Co., U. S. Steel Corp. Subsidiary
Inland Steel Co.
Tennessee Coal, Iron & Railroad Co., U. S. Steel Corp. Subsidiary

Spring
American Steel & Wire Co., U. S. Steel Corp. Subsidiary
Barnes Co., Wallace, Div. of Associated Spring Corp.
Barnes - Gibson - Raymond, Div. of Associated Spring Corp.
Gibson Co., Wm. O., Div. of Associated Spring Corp.
Union Drawn Steel Co.

Stainless
American Steel & Wire Co., U. S. Steel Corp. Subsidiary.
Bethlehem Steel Co.
Carnegie - Illinois Steel Corp., U. S. Steel Corp. Subsidiary
Columbia Steel Co., U. S. Steel Corp. Subsidiary

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Come to Cotta for SPECIAL ENGINEERED HEAVY-DUTY TRANSMISSIONS
7300 ELEVENTH STREET
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An Assurance of Dependable Service

BUYERS' GUIDE—Continued

National Tube Co., U. S. Steel Corp. Subsidiary
Republic Steel Corp.
Tennessee Coal, Iron & Railroad Co., U. S. Steel Corp. Subsidiary
Union Drawn Steel Co.
Vanadium-Alloys Steel Co.

Strip
Bethlehem Steel Co.
Inland Steel Co.
Republic Steel Co.

Structural
Inland Steel Co.

Tool
Vanadium-Alloys Steel Co.

Vanadium
Republic Steel Co.
Union Drawn Steel Co.
Vanadium-Alloys Steel Co.

Supplies, Die Makers'
Danly Machine Specialties, Inc.

Switches, Power (for Resistance Welders)
Westinghouse Elec. & Mfg. Co.

Tapping Machines
Bullard Co.

Taps
National Acme Co.

Thermostats
Fulton Sylphon Co.

Transformers, Electric
Westinghouse Electric & Mfg. Co.

Transmissions
Cotta Transmission Corp. (Heavy Duty)

Tubing

Alloy, Seamless & Stainless
National Tube Co., U. S. Steel Corp. Subsidiary

Steel
Timken Roller Bearing Co.

Turret Machines, Automatic
Bullard Co.
Potter & Johnston Machine Co.

Universal Joints
Mechanics Universal Joint Co., Div. Borg-Warner Corp.

Washers

Felt
American Felt Co.

Lock
Thompson-Bremer & Co.

Welders
Harnischfeger Corp.
Westinghouse Electric & Mfg. Co. (Electric)

Welding Electrodes
Harnischfeger Corp.

Welding Material
P. R. Mallory & Co., Inc. (Dies for Arc & Resistance Welding)

Wicks, Felt
American Felt Co.

Window Regulators
Ackerman - Blaesser-Fezzy, Inc.

Wire

Cloth
Wickwire Spencer Steel Co.

Flat, Round, Square or Special Shapes
Barnes Co., Wallace, Div. of Associated Spring Corp.
Bethlehem Steel Co.
Wickwire Spencer Steel Co.

Piano and Music
Wickwire Spencer Steel Co.

Spring
Barnes Co., Wallace, Div. of Associated Spring Corp.
Republic Steel Co.

Wire Rope
Wickwire Spencer Steel Co.

Zinc, Sheets, Slabs, Sticks, Strip, etc.
New Jersey Zinc Co.

Men at work

in all corners of automotive industrial manufacturing plants influence the buying of materials, tools, machinery and equipment.

The men on whose practical judgment the choice of a specified purchase sometimes rests may very well be those upon whom the salesman for the supplying manufacturer does not—and cannot—call.

That is where Automotive Industries enters the selling picture for the supplier.

It helps to create and to maintain the good reputation for a product in quarters where that help will do the most good—among these unidentified influences in plant purchases of all kinds—in addition, of course, to the administrative and other executives.

AUTOMOTIVE INDUSTRIES

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Index to Advertisers

This Advertisers' Index is published as a convenience, and not as part of the advertising contract. Every care will be taken to index correctly. No allowance will be made for errors or failure to insert.

AC Spark Plug Div. General Motors Corp. —
Accurate Spring Mfg. Co. —
Acheson Colloids Co. 650
Ackerman Blaesser-Fezzey, Inc. 70
Aetna Ball Bearing Mfg. Co. —
Air Reduction Sales Co. —
Aluminum Co. of America..Back Cover
American Bosch Corp. —
American Cable (Div. Amer. Chain & Cable Co., Inc.) —
American Chain & Cable Co., Inc. —
American Chemical Paint Co. —
American Coil Spring Co. —
American Felt Co. 75
American Screw Co. —
American Steel & Wire Co.....4-64-68
Atlas Drop Forge Co. 76

Bakelite Corp. —
Bantam Bearings Corp. (Subsidiary of The Torrington Co.) 73
Barber-Colman Co. 80
Barnes Company, Wallace, Div. Associated Spring Co. —
Barnes-Gibson-Raymond, Div. Associated Spring Co. 72
Bearings Co. of America —
Bendix Products Div. of Bendix Aviation Corp. —
Berger Mfg. Div. 54-55
Bethlehem Steel Co. 60-61
Bijur Lubricating Corp. —
Bliss & Laughlin, Inc. —
Borg & Beck Division Borg-Warner Corp. 3
Bower Roller Bearing Co. —
Brown-Lipe Gear Co. —
Bullard Co., The 2
Bundy Tubing Co. —
Bunting Brass & Bronze Co., The. —

Carboloy Co., Inc. —
Carnegie-Illinois Steel Corp....4-64-68
Chandler Products Co. —
Cincinnati Milling Machine Co., The —
Cities Service Oil Co. 351
Clearing Machine Corp. —
Climax Molybdenum Co. —
Columbia Steel Co. 4-64-68
Continental Motors Corp. —
Continental Screw Co. —
Corbin Screw Corp. —
Cotta Transmission Corp. 76
Cummins Engine Co. —
Curtis Pneumatic Machinery Co... —

Danly Machine Specialties, Inc..... 76
Delta Mfg. Co. (Industrial Division) —
Dole Valve Co., The —
du Pont de Nemours & Co., E. I. (du Pont Plastics Division)..... 67
du Pont de Nemours & Co. (Inc.). E. I. (Rubber Chemicals Division) 62
Durez Plastics & Chemicals, Inc... —
Duro Metal Products Co..... —

Eclipse Machine (Division Bendix Aviation Corp.) —
Ethyl Gasoline Corp. 65

Federal Bearings Co., Inc., The... 79
Federal-Mogul Corp. —
Foote Bros. Gear & Machine Corp. —
Ford Motor Co. 77
Fulton Sylphon Co. 73

General Electric Co. 56-57
Gibson Company, Wm. D., Div. Associated Spring Co. —
Govro-Nelson Co. 70

Harnischfeger Corp. —
Harrison Radiator Div. General Motors Corp. —
Heald Machine Co., The.....2nd Cover
Hoof Products Co. —
Hotel Lincoln (Indianapolis)..... 70
Hotel Radisson (Minneapolis)..... 76
Hotel Wisconsin (Milwaukee)..... 75
Hyatt Bearings, Div. General Motors Sales Corp. ?

Inland Steel Co. 10
International Nickel Co., Inc. —

Johanson Division (Ford Motor Co.) 77
Jones & Laughlin Steel Corp. American Iron & Steel Works.. —

King-Seeley Corp. —

Laminated Shim Co., Inc. —
Lamson & Sessions Co. —
La Salle Steel Co. —
Lincoln Electric Co., The —
Littell Machine Co., F. J. 76

Maehler Co., Paul —
Mallory & Co., Inc., P. R. 59
Mechanics Universal Joint Division 75
Morse Chain Co. Div. Borg-Warner Corp. —
Motor Improvements, Inc. —
Motors Metals Mfg. Co. 76

National Acme Co., The 5
National Broach & Machine Co... —
National Screw & Mfg. Co. —
National Tube Co. 4-64-68
New Departure Mfg. Co., Div. of General Motors Corp.....Front Cover
New Jersey Zinc Co., The 63
Niles Steel Products Division....54-55
North American Electric Lamp Co. —

Parish Pressed Steel Co. —
Parker-Kalon Corp. —
Parker Rust Proof Co. —
Pheoll Mfg. Co. —
Poor & Co. (Canton Forge—Axle Works) —
Potter & Johnston Machine Co.... 75
Pratt & Whitney (Division Niles-Bement-Pond, Co.) —
Progressive Mfg. Co. 70

Raymond Mfg. Co. (Div. Associated Spring Corp.) —
Republic Steel Corp., Alloy Steel Division 54-55
Rockford Screw Products Co. 74
Ruby Chemical Co. —
Russell Burdsall & Ward Bolt & Nut Co. —
Ryerson & Son, Inc., Joseph T.... —

SKF Industries, Inc. —
Salisbury Axle Co. —
Schrader's Son, A. (Div. of Scovill Mfg. Co., Inc.) —
Scovill Mfg. Co. —
Shakeproof Lock Washer Co., ... —
Shore Instrument & Mfg. Co., The —
Shuler Axle Co., Inc. —
Simon and Schuster, Inc. 69
Spicer Mfg. Corp. —
Spring Washer Industry —
Standard Oil Co. (Indiana) —
Steel & Tubes, Inc. 54-55
Strom Steel Ball Co. —
Stuart Oil Co., Ltd., D. A. —
Sun Oil Company —

Texas Co., The —
Thompson-Bremer & Co.....3rd Cover
Timken Roller Bearing Co., Front Cover
Torrington Co., The —
Truscon Steel Co. 54-55
Twin Disc Clutch Co. 8

Union Drawn Steel (Div. of Republic Steel Corp.) 54-55
United States Steel Corp. 4-64-68

Vanadium-Alloys Steel Co. 6
Victor Mfg. & Gasket Co. —

Wagner Electric Corp. —
Waukesha Motor Co. 1
Western Felt Works —
Westinghouse Electric & Mfg. Co. 58
White Dental Mfg. Co., S. S., The (Industrial Division) 71
Wickwire Spencer Steel Co. —
Wilcox-Rich Division of Eaton Mfg. Co. —
Wittek Mfg. Co. 76
Worcester Stamped Metal Co. 76
Wyman-Gordon 652

Young Radiator Co. —

Zollner Machine Works —

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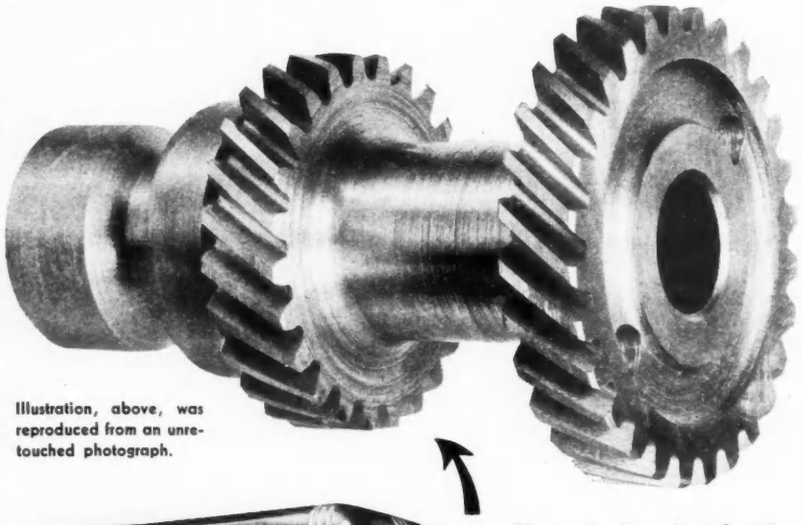
BEARINGS

Tops for High Quality Production

TYPE V Barber-Colman Vertical Hobbing Machine

NEW Speed • *NEW* High Accuracy • *NEW* Fine Finish

"Best gears ever cut on a hobbing machine" was said about a lot of cluster gears shown at right as cut on Barber-Colman Type V Hobbing Machine. Unusually close limits were held, production increased 75% . . . see data at right. Finish . . . superb! Production, accuracy, finish; any one of these might have been equalled by other means, but Type V produced *all three in combination* . . . and that's tops in high quality production hobbing. What Type V is doing on gears shown, it has equalled or exceeded on others. Here are the basic reasons:



Illustration, above, was reproduced from an unretouched photograph.

Unique Type V Vertical Design simplifies construction and operation, saves floor space, gives complete accessibility. Massive deep-section frame is enormously strong and rigid. Work-slide feeds upward; gravity aids rapid traverse downward, drops chips and coolant directly into chute.

Automatic Operating Cycle employs highly effective combination of *hydraulic, mechanical* and *electrical* operating means; includes conventional or climb cutting.

Quick Set-up—Speed, feed, and index gears are selected quickly, mounted easily. Simple adjustments establish work-slide movement and positive depth of cut. Central controls give individual command of cycle motions.

Investigate. Bulletin 1645 fully describes the many features and advantages that make the Type V Hobbing Machine an outstanding producer. Write, today, for a copy.

Type V Vertical Hobbing Machine.

Here is Production!

The Work: Helical gear indicated in cluster above; 24 teeth, 9.25 pitch, 0.775" face. Material: S.A.E. 5140 steel, 180 Brinell hardness.

	Former Method	B-C Type V
Feed	.059"	.070"
Hob r.p.m.	170	300
Hob diameter	3"	4"
Hob threads	2	2
Cutting time	2.20 min.	1.15 min.
Change time	.25 min.	.25 min.
Floor-to-floor time	2.45 min.	1.40 min.
Production per hour	24	42
Accuracy of involute within	.....	.0005"
Accuracy of Index, within	.....	.0005"

Similar results obtained on the other gear, 28 teeth.

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HOBS, HOBBING MACHINES, HOB SHARPENING MACHINES, REAMERS, REAMER SHARPENING MACHINES, MILLING CUTTERS, SPECIAL TOOLS

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Lynite T-Slot LO-EX Pistons insure maximum heat flow, coefficient of expansion is low, clearances can be close. Their lighter weight reduces bearing pressures, so bearings last longer. Gas and oil consumption and carbon formation are held to a minimum.

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